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UNIVERSITY OF ALBERTA

MODELLING CHINESE NUPTIALITY

BY

YAN JIN

(C)

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Arts.

IN

DEMOGRAPHY

DEPARTMENT OF SOCIOLOGY

EDMONTON, ALBERTA

FALL 1991

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Jerome N. Sheahan

Dr. J. Sheahan

DATED September 16, 1991

To

My Parents

Abstract

Although marriage has its importance in demography, it has not been studied so well as mortality and fertility. Demographers have done many studies in mortality and fertility, and attempted to investigate regularities in the age distributions of death and birth rates. For example, model life tables and model fertility schedules are well established for population projections, estimations and other research. The less degree of studies in marriage is due to lack of or less accurate information, especially in the less developed countries.

In this thesis, three models are developed and used to fit and graduate age pattern of first marriage for China. The three models are piece-wise Pareto distribution, generalized logistic curve and generalized Gompertz function. It is found that these are satisfactory models for Chinese nuptiality. In particular, the first two are promising. The data for this study come from China 1% Population Sampling Survey conducted in 1987.

In the course of the study, moreover, marriage trend, gender and rural-urban differentials are analyzed systematically. The analysis reveals that Chinese nuptiality has changed dramatically and early marriage has dropped sharply. The mean age at first marriage has increased and the

variance decreased. It is also seen that gender differentials in age pattern of first marriage in both rural and urban China have narrowed down with the changes in marriage situation. On the other hand, rural-urban differences have enlarged for both males and females. The implications of these changes are drawn.

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CHAPTER 1

Introduction

Marital status is a key demographic and socio-economic variable which is defined as: single, married, divorced, and widowed (Bogue, 1969:312). It is an important factor in population dynamics, as it affects fertility tremendously and mortality and migration to a lesser extent. In other words, marital status influences the course of population growth. For example, since childbearing outside marriage occurs rarely in most societies, marriage is the first step for fertility. Many studies have found that fertility is directly affected by marriage patterns, such as age at and duration of marriage. Moreover, both death and migration rates vary substantially according to marital status (Bogue, 1969:312; Weeks, 1989:167-168, 191). Married people tend to live longer than the unmarried (Kisker & Goldman, 1987).

Marital status has effects on social and economic characteristics, as well. It has major implications for school attendance, labour force participation, social problems (i.e. suicide), and crime. In general, marital status has direct and indirect influences in many areas of social science. Study of marital status plays an important role in social sciences, particularly in demography.

1.1 Purpose of This Study

The importance of marital status has led scientists to develop many models to understand this phenomenon. In the early studies, Hajnal (1953) formulated a method to compute singulate mean age at first marriage and changes in marriage rates from proportions single. Later on, nuptiality tables and many models for studying marriage patterns were built (Mertens, 1965; Krishnan, 1971; Coale and McNeil, 1972; etc.). Most of these models focus on nuptiality (marriage) because of data availability.

However, nuptiality is the great unknown of many demographic phenomena. It is not developed to the extent of fertility, mortality and migration due to less accurate information, especially for the less developed countries.

It is surprising to note that little research was available on the demography of China some years ago (Wei, 1983). Indeed, demography is a new science in China. With economic reformation taking place, the government has begun to release its demographic data gradually. Since the late 1970s or early 1980s, more and more population studies have been conducted and demographic courses offered under various departments in selected universities. However, most of the concentration of demographic research is on Chinese fertility first, and then on mortality and migration. Only a few studies deal with Chinese marriage and family. In this thesis, we are

concerned with mathematical models to simulate the age pattern of first marriage, construction of nuptiality tables for investigating marriage patterns, and preliminary analysis of marriage trends and differences by gender and residence in China. A brief survey of these topics, therefore, will be given to show the relevance of the study attempted here.

1.2 Theoretical Framework

Theory is the building block for model-building. Theories of marriage will be reviewed first in the study. Becker (1973, 1974) develops a theory of marriage by introducing search for a spouse from the economic point of view. He shows (1973) that the commodity output of a married couple depends upon the combination of the characteristics of both of them. Keely (1977, 1979) summarizes Becker's theoretical work as:

"Search for a spouse may be conceptualized as a process similar to the search for a job. A single person enters the market to search for a spouse only if the expected benefits from search exceed the cost. If the benefits exceed the costs, then the searcher decides on a minimum acceptance wage which is determined by equating the marginal expected benefits from search to the marginal costs. The searcher accepts any offer of marriage that equals or exceeds his acceptance wage. If the costs or benefits of search change during the search process due, for example, to changing market conditions, then the

searcher would withdraw from the search if the expected benefits from continued search were less than the costs."

When a cohort reaches the marriageable age, the marriage market is large for them and they have many choices. Thus a searcher can be easier to reach his/her expected benefits and hence he/she has a higher probability of getting married. On the other hand, after a certain age when a large proportion of the cohort has married, the market becomes smaller and smaller, and the cost of search increases. Thus, it is harder for the searcher to make his/her expected benefits real and the marriage probability appears to decrease. In the societies with "arranged marriage", the search work is done by the parents.

From the sociological point of view, an increase in force of social pressure and force of marriage attraction increases the probability of entry into wedlock. As long as a female stays in the single state, the social stigma will follow her (Krishnan, 1971). For a male who remains in that state, the questions of masculinity and mental health arise (Hernes, 1972). Besides the social pressure, happiness of marriage from his/her counterpart attracts him/her to enter into wedlock. When single persons age, both factors increase. Therefore, the probability of getting married increases in the early years of marriageable time.

On the other hand, marriageability generally declines with age. Youthfulness is much valued in most societies. The

younger the person, the more attractive he/she is. In addition, after a large proportion of a cohort gets married, the number of potential marriage partners in the same age-group declines. Thus the risk of marriage is likely to decline, making it harder to find a good match. According to the principle of cumulative inertia introduced by McGinnis (1968) in the study of social mobility, the probability of remaining in single state increases as a single person ages. In light of the discussion above, therefore, the probability of entering into wedlock increases till a certain age, and then declines.

1.3 Mathematical Models in Nuptiality

A model of age pattern of first marriage was developed by Coale and McNeil in 1972. Coale (1971) found regularities in the age patterns marriage and observed the existence of a regular structure in the pattern of entry into first marriage for female cohorts for a wide range of countries and time periods. The curves of proportion ever-married (which are the cumulation of the frequency distribution of first marriages) among groups with very different socio-economic characteristics are uniform in the sense that a particular curve may be expressed in terms of a standard curve by adjusting its origin, horizontal, and vertical scales. Coale showed three parameters could determine the marriage patterns,

namely the mean age at first marriage, the standard deviation of age at first marriage, and the proportion ever married in the cohort. Based on Coale's study, Keeley (1979) presented a log-logistic model of analyzing the entire distribution function of first marriage.

Hernes (1972) formulated a non-homogenous diffusion model in continuous time for the process of entry into first marriage. Using the stochastic modelling approach, almost at the same time, Krishnan (1971) developed a model of first marriage with the Pareto distribution (in continuous time). With the application of McGinnis' principle of cumulative inertia (1968) to the first marriage in this model, Krishnan stated "If a female continues to stay in unmarried state for a long time, her annual risk of marriage presumably decreases monotonically with time tending to zero in the limit. This suggests that the attrition or hazard rate is a decreasing one."

Mishra (1979) introduced a discrete model dealing with data available in five-year age groups. The basic idea behind the model is that the probability of getting success in the (i+1)th trial when it is known that the first i trials resulted in failure, i=0, 1, 2, ..., increases as i moves from zero to a certain value, decrease monotonically as i moves from "s" to a value "t" (t>=s) and then remains constant thereafter. From a practical point of view, Mishra's model may not be useful for data with one-year age groups, for, in such

a case, many parameters have to be estimated, and thus the model may become too complex for use.

1.4 Nuptiality Tables

Perhaps the most refined tool for investigating marriage patterns is the nuptiality tables. There are basically two types of nuptiality tables, namely gross and net nuptiality tables. The former shows the primarily impact of nuptiality independent of mortality. The latter takes mortality into account. Both tables reflect only first marriage. Gross nuptiality tables has a great advantage when one has to study comparative nuptiality patterns among populations with different mortality pattern or the phenomenon of nuptiality in its pure state (Bogue, 1969:626; Shryock and Siegel, 1976:338-340).

The methodology of nuptiality table construction is discussed in depth in Mertens (1965), Bogue (1969:626-631), and Shryock and Siegel (1976, 338-340). The life table approach is utilized in the construction of nuptiality tables. The main step in gross tables is to obtain the age specific nuptiality rates, the probabilities that a person who is single at birthday x will marry before attaining birthday x+k+1, where (x,x+k) is the age interval under consideration. These probabilities are computed from central rates of first marriage, employing the approximation used in life tables. In

net tables, two rates or a dependent mixed rate at each age group (Mertens, 1965) is computed, which is subject to the force of nuptiality and of mortality. A hypothetical cohort of single population, say 100,000 at age 15 or at the beginning of an age interval in which marriage starts, is given in both gross and net nuptiality tables. Thus we are able to estimate the number of single population at the beginning of each age group.

The columns comprising gross tables are presented as follows because of its advantage mentioned above (One may refer to Table E-1 in Appendix E).

COLUMN 1 Nuptiality rate (n_x) at the age interval (x,x+1). We take one-year age interval.

COLUMN 2 N_x is the number of never married at age x, which is computed as $N_{x+1} = N_x(1-n_x)$. At age 15, N_{15}=100,000---the initial cohort of single population.

COLUMN 3 M_x is defined as the number of marrying in the age interval (x,x+1). Obviously, M_x is the product of $N_x n_x$.

COLUMN 4 Number ever marrying (ML_x). ML_x is the number of persons who, when they attain age x, will marry during next year or sometime in the future. It is a cumulative number of column 3 from the bottom (foot) of the table upward.

COLUMN 5 EVM_x is the number of ever-married persons. It is calculated by cumulating column 3 downward from age x.

COLUMN 6 Person years in never-married status (S_x). The number of person years spent in single status is given by the average

of N_x and N_{x+1}.

COLUMN 7 Cumulative single person years (NEV_x). The column presents the total number of person years spent in the never-married status by the cohort year of age x and all subsequent years. It is a cumulative number of column 6 from the foot of the table upward.

COLUMN 8 Percentage ever marrying (pM_x). This column expresses that a person at age x will marry during lifetime before reaching the end of the table. It is computed by dividing the entry in column 4 by the corresponding entry in column 2.

COLUMN 9 Average years before marriage (e^n_x). To obtain the average number of years that a single person will spend before his/her marriage is obtained by dividing the entry in column 7 by the corresponding entry in column 2.

1.5 Differentials in Nuptiality Patterns and Marriage Trends

Differentials in marriage patterns do exist in the world and the patterns vary from time to time, nation to nation, and subgroup to subgroup (Hajnal, 1953; Bogue, 1969:316-336; Kalbach and McVey, 1979:306-309; Weeks, 1989:268-270). Empirical studies find that many socio-economic and demographic factors, i.e. occupation, education, income, religion, ethnicity, age, sex, and urbanization, have effects on marriage (Laing and Krishnan, 1976; Keely, 1977 and 1979; Zhong, 1983; Bennett, Bloom and Craig, 1989).

For example, the mean age at marriage in the less developed countries is younger than that in the developed countries. Bogue (1969: 329-336) notes that males tend to marry later than females. As a consequence, the proportion of never-married young males is universally larger than that of females. Both males and females in rural areas are likely to marry earlier than their urban counterparts.

Although marriage patterns are different between the developed and the less developed countries, there appears to be a tendency toward convergence of the globe's marriage patterns (Bogue, 1969:336). He stated that "in the economically advanced nations marriage is tending to occur earlier, and in the developing nations it is tending to occur later." Hajnal (1953) first studied this phenomenon and placed it in a historical perspective. However, more recent studies find that a delay in marriage has happened in the developed countries too (Laing and Krishnan, 1976; Weeks, 1989:301; Bennett, Bloom and Craig, 1989). This delay might be largely due to marriage squeeze, urbanization and modernization. Therefore, Bogue's statement about the developed nations is true only for the time period of "marriage boom and baby boom". But the convergent tendency may hold true because of differential delay rates in marriage for both developed and less developed countries.

CHAPTER 2

A History of Marriage in China

Since China closed its door to the world about thirty years, Chinese marriage may have looked mysterious. As a matter of fact, like marriage in other countries, Chinese marriage is also affected by many cultural, socio-economic, demographic, political, and law-related factors. In order to understand marriage better in China, a brief picture of Chinese marriage is presented in this chapter. Discussions are mainly concentrated on Chinese female marriage as information about males is usually unavailable.

2.1 Marriage in Prerevolutionary China

Marriage in traditional or prerevolutionary China was guided by traditional customs, religion, and feudal ethics. In Confucian ideology, marriage should be arranged by parents, and young people did not have the right to make the mate selection. Marriage was a contract between families rather than one between individuals. The mate search and selection were based on family needs and values in terms of wealth, social status and power rather than on attraction, love, or emotional involvement. Therefore, socio-economic status or

class was the most important criterion of evaluation in the matchmaking process (Engel, 1984). Besides arranged marriage, "marriage by purchase" and dowry did occur very often, and concubinage or polygamy did exist, especially among rich families. Personal attraction and love between bride and groom were considered unnecessary, and hence precautions, persuasions, and even intimidation were often used to prevent emotional involvements from disrupting family stability (Lang, 1946; Engel, 1984; Chu, 1985).

2.2 Marriage Laws for the People's Republic of China

With the formation of the People's Republic in 1949, the old marriage system was abandoned. In order to make fundamental changes in marriage and family relationships, a marriage law was promulgated in 1950 advocating free marriage, monogamy and equal rights between husbands and wives. According to this law (Kristeva, 1975-76; Meijer, 1975: Engel, 1984), "the feudal marriage system ... shall be abolished .... The New Democratic marriage system ... shall be put into effect." Legal ages of marriage for females and males are determined in the article of the marriage law which is the minimum age of marriage is 18 for females and 20 for males. Dramatic changes have occurred since then. Wei (1984) summarizes:

1. Monogamy has come true at last. Before, there

were many cases of polygamy, especially among the rich. Now, monogamy has been safeguarded by the Marriage Law, and polygamy forbidden.

2. There has been a shift from arranged to free marriages, especially in the cities.
3. Among young people,there is a tendency to marry at a late age. That challenges the old tradition to some extent.

In spite of 30 years of practice of the marriage law, China still faces serious problems as fast population growth, arranged and mercenary marriages, and other kinds of interference with free marriage which cause unhappy marriage and family life, which, in turn, make the society unstable (Wei, 1983; Engel, 1984; Chu, 1985-86). This led the Chinese government to modify and control marriage and family relationships. A new marriage law was promulgated in 1980 and took effect in 1981 (Beijing review, 1981c: 24-27).

On comparing the new marriage law with the old one, some differences can be noticed as below. First, the minimum legal age of marriage is raised from 18 to 20 for females and from 20 to 22 for males. Second, the restrictions on divorce is relaxed to some extent. Third, birth control is taken into account and one couple one child policy encouraged. The new marriage law puts both husbands and wives under the obligation of family planning practice. Fourth, prohibition marriage between a man and a woman with collateral blood relationship

(up to the third degree) is included in the new marriage law.

2.3 Trends in Age Pattern of Marriage

On July 1, 1982, a census was conducted in China. At the same time, a one-per-thousand fertility survey was taken to complement the census about fertility and marriage. After that, studies of marriage for the whole country became available. Based on data from the One-per-Thousand Population Fertility Survey in 1982, marriage trend with age distributions in China has been studied.

In prerevolutionary China, arrangement of marriage was dominant in the marriage market. Because of family needs and values, tradition, and religion, child marriage and early marriage were very popular. In 1940, for example, 51.5% of girls under age 18 were married and the mean age at first marriage was around 18 (Zhang, 1986). The peak age at first marriage for females was only 15 at the same time (Zhao, 1983). Child and early marriages were important characteristics of age pattern of marriage at that time.

After the establishment of the People's Republic, there have been great changes in the age pattern of marriage. According to the official policies toward marriage and fertility, age pattern of marriage during 1949-82 can be distinguished for the three time periods: 1949-69, 1970-80, and since 1980.

1. The first stage is from 1949 to 1969. There was a slow increase in the mean age at first marriage and a decrease in early marriages, and a high rate of fertility. The mean age at first marriage for females was 19.02 in the 1950s and 19.81 in the 1960s (Zhao, 1983). Among females aged 15 to 17, 48.3% in 1950, 32% in 1960, and 28.5% in 1965 were married (Zhang, 1986). However, the total fertility rate remained unchanged and high during that period. It was 5.72 births per woman in 1969 (Xiao, et al., 1983). As Zhao and Yu (1983) discussed, the changes in age pattern of marriage may be partly due to social and economic development and political fluctuations (i.e. the ten year Cultural Revolution).

2. From 1970 to 1980 China adopted a strong birth control policy and encouraged late marriage. Under the *"wen xi shao"* policy (literally "late, sparse and few", a policy calling for late marriage and childbearing, larger spacing, and fewer children) that was in effect during the 1970s, the mean age and the peak age at first marriage for females increased from 20.2 and 19 in 1970 to 22.6 and 22 in 1977, respectively (Zhao and Yu, 1983). After the one-child policy introduced in 1978, the two ages jumped up to 23.1 and 23 in 1980 (Zhao and Yu, 1983). Meanwhile, the total fertility rate dropped from 5.93 per woman in 1970 to 2.66 in 1979 (Coale, 1984).

3. From 1981 to 1982 there was a decreasing tendency to the mean age at first marriage. For example, the mean age for females in 1982 was 22.7 (Zhao and Yu, 1983). This tendency

may be due to the new marriage law.

In general, Chinese marriage tends to occur late but reasons for the changes may be different from those in developed countries. Although there are changes in age pattern of first marriage, the proportion ever-married for females remains unchanged. Since 1949, fewer than one-half of one percent of women have never married by their 35th birthday (Zhao, 1983; Zhong, 1983; Zen, 1988). Zen (1988) concludes from this finding that for all practical purposes, we may accept marriage in China as being universal.

2.4 Rural and Urban Differentials in Marriage

Empirical studies of rural-urban marriages have found that rural-urban differentials in the age pattern of marriage do exist in contemporary China. Persons in urban areas marry later than their counterparts in rural areas. Findings in Zhao's study (1983) suggest that the mean age at first marriage for females was about 2 years later in urban China than that in rural China in the 1950s and 1960s, 3 years later in the 1970s, and 2.5 years later in the early 1980s. Similar results are also found by Zhao and Yu (1983) and Zhang (1986).

Zhong (1983) views the difference in another way, say, difference in proportion ever-married. Based on the period data in 1982 from the One-per-Thousand Population Fertility

Survey, he finds that the proportion ever-married in urban China is lower than that in rural China for females aged 30 or younger. After the age of 30, the difference becomes smaller and smaller. Teenage marriages or early marriages are much higher in rural places. The proportion ever-married in the age group 15-19 is 5.19% in rural and 0.06% in urban areas. In general, the younger the age, the greater the difference of proportion ever-married between the two areas.

2.5 Gender Differentials in Marriage

Most of the Chinese marriage studies deal with female marriage because of the importance of female marriage with respect to fertility. A comparative analysis of age pattern of first marriage by gender is done by Gu (1986), based on 1982 Census data. The findings of his study suggest that males tend to marry 2.2 years later, on an average, than females. The median age at first marriage is about 24 for males and 22 for females. In all age groups above 15, proportions ever marrying for males are lower than that for females. This indicates that more males stay in never married category than females. The same results are also found in Banister's study (1984). Gu explains that the differences are mainly caused by a favoured sex ratio to males. The sex ratio above age 15 is 105 (105 males per 100 females).

In summary, it is found that in China the types of

marriage have changed dramatically from child marriage to early marriage and then to late marriage. Empirical studies also confirm that the probability of getting married increases with increase in marriageable age to a certain point or a peak age, and then starts to decrease.

CHAPTER 3

Data and Methodology

This chapter is composed of two parts. The first part discusses the data employed in the analysis and the second one deals with mathematical models used for graduation of the age pattern of first marriage.

3.1 Data

The data used in this study are cohort data from the Tabulations of One-Percent-Population Sample Survey in 1987. This survey was conducted by stratified, cluster and three-stage sampling, and used residential committees in urban areas and village committees in rural areas as ultimate sampling units. The ultimate sampling units were selected on a probabilistic basis. Zero hour of July 1, 1987 was taken as the reference time for the survey. The sampling survey selected 12,540 residential committees and village committees among 6,270 neighbour-hoods (residential districts) in cities, towns and rural districts which, in turn, are among 1,045 cities and counties in the whole country. The survey sample covered a population (including the military) of 1,071 (in

wans[1]) of 249 (in *wans*) families representing almost one percent of the total population in China.

Banister (1984) has analyzed the recent data on Chinese population. He noted that "the wealth of good quality data (the 1982 Census data and the One-per-Thousand Population Fertility Sampling Survey data) now available on the demography of China provides much more reliable estimates of the country's population size and growth rate, its patterns of nuptiality, fertility, mortality, and urban-rural residence, and its labour force characteristics than ever before." The quality of the data from the sampling survey is known to be as good as the 1982 Census and the fertility survey data because almost the same procedures were used in the 1% population survey. According to the State Bureau of Statistics, the range of sampling error is $\pm$.011% for the birth rate of the first half year in 1987 and $\pm$.006% for the death rate. All the data were processed by a computer.

However, since mortality data in this survey are recall data and the recall time quite long, those that are far from the survey time have some deviations (State Bureau of Statistics, 1987). Also, there are age misreports on mortality at very high ages in some minorities in China in the 1982 Census data (Coale and Li,1991). All these indicate that the data for the age distributions of first marriage distant from the survey time may not be very accurate.

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[1]One *wan* equals to ten thousand.

3.2 Piece-wise Pareto Distribution and its Generalized Forms

The classical Pareto distribution is not only widely used in economics as the plausible form of income distribution in capitalist societies but can be used to represent various forms of distributions that arise in social sciences (Lange, 1978). Krishnan (1971) have found that the classical Pareto curve with truncation at both tails fits well the female age-distribution of first marriage in the United States.

3.2.1 Classical Pareto Distribution

The classical Pareto distribution has two parameters. Its probability function (p.f.) is given by

$$f(x,a,\theta) = \begin{cases} \theta a^{\theta}/x^{\theta+1}, & 0<a<x<\infty, \quad \theta>0 \\ 0, & otherwise \end{cases} \qquad (3.2.1.1)$$

where "a" is the starting point and "θ" the shape parameter. The c.d.f. is:

$$F(x,a,\theta) = 1 - (a/x)^{\theta} \qquad (3.2.1.2)$$

Then

$$\bar{F}(x,a,\theta) = 1 - F(x,a,\theta) = Ax^{-\theta} \qquad (3.2.1.3)$$

where $A=a^{\theta}$. For the income distribution in capitalistic societies, $\bar{F}(x)$ is the proportion of persons whose income exceeds x.

In practice, studies have shown that the beginning part

of the Pareto distribution does not fit well a observed distribution but the tail part does (Lange, 1978:180-201). Krishnan (1971) has shown that the hazard rate with a p.f. of the Pareto curve is a decreasing function. Thus it would be better to use the classical Pareto curve to fit a decreasing distribution.

In the study under consideration, we take the parameter "a" as the peak age (mode) of an age pattern of first marriage since the number of persons entering into wedlock begin to decrease in each age group after the peak age. In other words, we use the classical Pareto distribution to fit the right side (after the peak age) of the age distribution of first marriage.

However, scientists are not very satisfied with the classical Pareto distribution. They have attempted to modify the classical Pareto distribution to make the curve fit better (Mardia, 1962; Krishnan, et al., 1990). For other details, see Arnold (1983).

3.2.2 Generalized Forms of the Pareto Distribution

Krishnan, Ng and Shihadeh have formulated a set of generalized forms of the Pareto distribution by changing the elasticity function. The general elasticity function in x is given by

$$\frac{\partial \ln \bar{F}}{\partial \ln x} = -\theta - \sum_{i=1}^{n} \beta_i x^i \qquad (3.2.1.4)$$

Then, the generalized Pareto curve is:

$$\bar{F}(x) = cx^{-\theta}\exp\left(-\sum_{i=1}^{n} \beta_i x^i\right)$$
$$= x^{-\theta}\exp\left(-\sum_{i=0}^{n} \beta_i x^i\right) \qquad (3.2.1.5)$$

where c is a constant and $c = \exp(-\beta_0)$. The exponential term in (3.2.1.5) is used to adjust the Pareto curve. Therefore, parameter β^i (i=1,...,n) can be called as change parameters of the shape.

When i=1, it is the Generalized Linear Pareto Curve (GLPC):

$$\bar{F}(x) = x^{-\theta}\exp\left(-(\beta_0 + \beta_1 x)\right) \qquad (3.2.1.6)$$

where β_1 is the linear change parameter of the shape. When i=2, it is the Generalized Quadratic Pareto Curve (GQPC):

$$\bar{F}(x) = x^{-\theta}\exp\left(-(\beta_0 + \beta_1 x + \beta_2 x^2)\right) \qquad (3.2.1.7)$$

where β_1 and β_2 are the linear and quadratic change parameters of the shape.

3.2.3 Reverse Pareto Distribution

If we turn over the classical Pareto curve at the line x=a, we have an increasing distribution of x which is called the simple reverse Pareto distribution (Krishnan, 1986). The p.f. of the simple reverse Pareto distribution with two

parameters is defined as

$$f(x,a,\alpha) = \begin{cases} \frac{\alpha}{a^{\alpha}} x^{\alpha-1} & 0 < x \le a, \quad \alpha > 1 \\ 0 & otherwise \end{cases} \qquad (3.2.3.1)$$

The parameter "a" is the point at which the curve ends and "α" the shape parameter. Note, this form is very similar to the p.f. of the classical Pareto distribution. The c.d.f. is:

$$\begin{aligned} F(x,a,\alpha) &= (x/a)^{\alpha} \\ &= cx^{\alpha} \end{aligned} \qquad (3.2.3.2)$$

where $c=1/a^{\alpha}$. F(x) is the proportion of the individuals whose value is less than or equal to x.

The hazard rate or the force of marriage attraction for the increasing part of first marriage curve is defined as

$$\begin{aligned} h(x) &= \frac{f(x)}{1-F(x)} \\ &= \frac{\frac{\alpha}{a^{\alpha}} x^{\alpha-1}}{1-(\frac{x}{\alpha})^{\alpha}} \\ &= \frac{\alpha x^{\alpha-1}}{a^{\alpha}-x^{\alpha}} \end{aligned} \qquad (3.2.3.3)$$

Obviously, h(x) is an increasing function. Thus the reverse Pareto curve can be used to fit the left side of the age pattern of first marriage.

Using the same elasticity approach discussed in Section 3.2.2, the generalized forms of the simple reverse Pareto curve can be derived as follows:

$$\frac{\partial \ln F(x)}{\partial \ln x} = \alpha + \sum_{i=1}^{n} \beta_i x^i \qquad (3.2.3.4)$$

Then we have

$$F(x) = cx^{\alpha}\exp\left(\sum_{i=1}^{n}\beta_i x^i\right)$$
$$= x^{\alpha}\exp\left(\sum_{i=0}^{n}\beta_i x^i\right) \qquad (3.2.3.5)$$

where $c=\exp(\beta_0)$. The Generalized Linear Reverse Pareto Curve (GLRPC), when i=1, is given by

$$F(x) = x^{\alpha}\exp(\beta_0+\beta_1 x) \qquad (3.2.3.6)$$

The quadratic form, as i=2, is

$$F(x) = x^{\alpha}\exp(\beta_0+\beta_1 x+\beta_2 x^2) \qquad (3.2.3.7)$$

3.3 Generalized Logistic Curve

Another way to build a mathematical model of marriage is to look at proportion ever-married, "P(x)", at any time x. Like the meaning of the proportion ever-married, the value of P(x) is between 0 and 1. When P(x)=0, it means nobody enters into wedlock. If P(x)=1, it says everyone is married which is the saturation level. According to the law of growth or Robertson's law of growth (Lange, 1978), the speed of growth of proportion ever-married is proportional to: (a) proportion ever-married at time x and (b) the distance of this proportion from the saturation level, which is the magnitude (1-P(x)). Hence we have

$$\frac{dP(x)}{dx} = kP(x)\,(1-P(x)) \qquad (3.3.1)$$

where k is a constant. Actually, formula (3.3.1) is the differential equation of the logistic function.

It is worth to note that (1-P(x)) is the proportion single at time x. Therefore, the speed of growth of proportion ever-married is determined by the interaction of the proportion ever-married and the proportion single at any moment. When the process of expansion approaches saturation, the proportion single (1-P(x)) approaches zero. This means that the growth of the function begins to stop, i.e. the function begins to stabilise near the level P(x)=1.

Since the proportion ever-married is modulated with time x, the general form should be

$$\frac{dP(x)}{dx} = P(x)\,(1-P(x))\,f(x) \qquad (3.3.2)$$

where f(x) is a function of time. When f(x) is a constant, (3.3.2) is the logistic function.

In the study under consideration, f(x) is approximated by a quadratic polynomial. Then the speed of growth of proportion ever-married is

$$\frac{dP(x)}{dx} = P(x)\,(1-P(x))\,(\alpha_0+\alpha_1 x+\alpha_2 x^2) \qquad (3.3.3)$$

Differential equation (3.3.3) can be solved[2] to obtain

$$P(x) = \frac{1}{1+\exp\left(-\left(C+\alpha_0 x+\frac{1}{2}\alpha_1 x^2+\frac{1}{3}\alpha_2 x^3\right)\right)} \qquad (3.3.4)$$

Rewriting (3.3.4), we obtain

$$P(x) = \frac{1}{1+\exp\left(-\left(\beta_0+\beta_1 x+\beta_2 x^2+\beta_3 x^3\right)\right)}, \quad x\geq 0, \qquad (3.3.5)$$

where, $\beta_0=C$, $\beta_1=\alpha_0$, $\beta_2=\alpha_1/2$, and $\beta_3=\alpha_2/3$.

Since P(x) tends to one when x tends to infinity, β_3 should be positive. The larger β_3, the faster the growth holding others constant. Moreover, β_0 should be negative because P(x) approaches zero when x approaches zero. It reflects the proportion ever-married at the starting point. The smaller β_0 (in view of the negative value), the fewer the marriages at the beginning of marriageable time.

3.4 Gompertz Function

The ordinary Gompertz function developed by Gompertz (1825) was suggested as an approximation of the mortality

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[2]Differential equation (3.3.3) can be solved as follows.

$$\frac{dP(x)}{P(x)\,(1-P(x))} = (\alpha_0+\alpha_1 x+\alpha_2 x^2)\,dx$$

$$\frac{dP(x)}{P(x)} + \frac{dP(x)}{1-P(x)} = (\alpha_0+\alpha_1 x+\alpha_2 x^2)\,dx$$

$$\ln P(x) - \ln(1-P(x)) = \alpha_0 x+\frac{1}{2}\alpha_1 x^2+\frac{1}{3}\alpha_2 x^3+C$$

$$\frac{P(x)}{1-P(x)} = \exp\left(\alpha_0 x+\frac{1}{2}\alpha_1 x^2+\frac{1}{3}\alpha_2 x^3+C\right)$$

hazard rate at age x:

$$h(x) = BC^x \qquad (3.4.1)$$

where B and C are constants. But it has been empirically found that this form is not satisfactory. Therefore several modifications of the Gompertz law have been made.

Krishnan and associates (1987) have developed several generalizations of the Gompertz curve. The general form is given by:

$$h(x) = \exp(\phi(x)) \qquad (3.4.2)$$

where $\phi(x)$ can be either a polynomial or an exponential function. The empirical results of the generalized function to fit mortality and fertility curves, especially the former, were promising in their study.

In the case of first marriage, h(x) is the nuptiality rate at age x. The polynomial function is utilized to fit nuptiality rates in the study. For interpretation purposes, we use the quadratic-Gompertz function for the curve fitting. This function is given by:

$$h(x) = \exp(\beta_0 + \beta_1 x + \beta_2 x^2), \qquad x \geq 0, \qquad (3.4.3)$$

where β_0, β_1 and β_2 are the parameters of the distribution.

On a logarithmic scale, β_0 is the intercept and β_1 and β_2 the growth and acceleration rates respectively. The term $\exp(\beta_0)$ is the probability of first marriage at the starting point. It reflects the probability of very early marriage if age 15 is measured as the starting point. Since the

probability approaches zero as x tends to zero, the value of β_0 must be less than zero. When x tends to a very old age, the marriage probability tends toward zero again, and hence β_2 has to be negative as well. Moreover, as the probability increases first and then decreases, the curve of nuptiality distribution should look like a humped parabola. So β_1 should be positive.

3.5 Nuptiality Rate

Like q_x in life tables, nuptiality rate is the fundamental function for the construction of nuptiality tables. Mertens (1965) has developed a method to derive the probabilities of first marriage. The basic idea comes from the life table approach, which is

$$n_x = \frac{2\,m_x}{2 + m_x} \qquad (3.5.1)$$

where n_x is the nuptiality rate at age x and m_x the central marriage rate.

Since the number of first marriages at each age for a cohort and the total population in the mid year of the survey year for the cohort are available in the study, we assume that there is no differential mortality between single and ever-married, and that nobody marries before age 15. Under these assumptions, we have

$$m_x = \frac{M_x}{T - \sum_{x=15}^{n} M_{x-1}} \quad , \quad (M_{14}=0), \qquad (3.5.2)$$

Here, M_x is the number of first marriages at age x and T the total mid-year population for a cohort. Applying m_x to equation (3.5.1), n_x can be easily obtained.

CHAPTER 4

Applications of the Models

In the preceding chapter, three models have been discussed as a means to curve fitting or graduation of first marriage. In this chapter, the models are applied to Chinese nuptiality by gender and rural-urban residence. Linear regression is used to obtain the initial estimates of parameters, then the non-linear regression routine in SPSSx is employed to obtain the final estimates (See SPSSx manual, Chapter 36). Since Chinese nuptiality has changed greatly after revolution, two types of data, namely old cohort and young cohort, are used to represent the different stages of Chinese nuptiality. Section 1 discusses why two specific cohort data by gender and residence are selected. Sections 2, 3 and 4 deal with the goodness of fit of the models and analysis of Chinese marriage. Section 5 is a summary to select the best model from among the three.

4.1 Data Selection and Truncation

It is discussed in Chapter 2 that the change of nuptiality in China can be approximately divided into three stages: from 1949 to 1969, 1970 to 1980, and the time period

after 1980. In order to investigate the trend of Chinese nuptiality, it is necessary to have three cohorts to represent the different stages. At the survey time, however, all cohorts representing stage three are too young to have enough cases. Moreover, the change of Chinese nuptiality from stage two to stage three is not so great as the one from stage one to stage two because of policies that encouraged late marriage. This has been confirmed by empirical studies (Zhang, 1986; Zhao, 1983; Zhao and Yu, 1983). Therefore, two cohorts by gender and residence are selected to represent stages one and two; one aged 50 in 1987 for stage one, and the other aged 35 for stage two.

There are three reasons to select the cohort aged 50. First, although the old marriage law was promulgated in 1950, traditional values and customs appeared to be remarkably resistant to change (Engel, 1984). This cohort was 18 years old in 1955, which is the minimum legal age of marriage for females by the old law. Five years after the marriage law came into effect, the resistance to change in marriage reduced to some extent. Second, all wars in which China was involved were over in 1955, and social and economic situations began to develop normally and stably. Third, we can assume that by age 50 marriage will be practically completed. Hence this cohort is a completed one. The cohort aged 35 in 1987 is used because this cohort was 18 years old in 1970 when late marriage began to be encouraged. Cohorts aged 50 and 35 are called, for

convenience, old and young respectively.

The young cohort is an incomplete one with respect to the assumption above. To make comparisons, the old cohort is truncated at the same age as of the young cohort. Krishnan (1971) has shown that the Pareto distribution is still useful in describing the marriage behaviour after truncation. Since the two cohorts are selected by gender and residence, we have eight sets of data in all.

The observed frequency distribution of first marriage and age-specific marriage rates for the two cohorts by gender and residence are given in Appendix A. It is evident from the tables in Appendix A that the general trend of annual risk of marriage increases to a maximum and then declines although the rates fluctuate. It indicates that the theoretical framework holds.

4.2 Estimates of Parameters in Piece-wise Pareto Distribution

Since both the rural and urban female old cohorts have only four cases on the increasing side, only the simple reverse Pareto curve is applied. For other data sets, the quadratic term does not exit in the generalized quadratic reverse Pareto distribution at the significance level 0.05. In the classical Pareto curve, the quadratic term is significant for some data sets but R-square change is very small which is indicative of no significant improvement in the fit. The

estimates of the parameters for the simple reverse Pareto and the generalized linear forms are presented in Tables 4.1 and 4.2.

R-squares for all data sets in both the reverse and classical Pareto distributions are above 99.5% which means the fit is good and Pareto curve can be used to describe first marriage in China. Appendix B shows the results of fitting.

From this appendix, it can be seen that most deviations between observed and derived values are below 1%. The largest deviation is less than 2% for the female young cohorts in rural and urban China and 4% for the old cohorts. For males, the largest one is less than 4% and 2% for the rural young and old cohorts, and 2% and 3% in urban areas, respectively. The index of dissimilarity between observed and derived proportions is quite small. For example, the largest one is less than 9% and the smallest one less than 3%. The large deviations for all cohorts in the study fall into the age bracket of 18-23 because the number of first marriages modulates most in this age group. The fluctuation indicates that persons may have a age preference for their weddings, i.e. age 20. All the indexes of dissimilarity for young cohorts are smaller than those for their old counterparts. This finding suggests that Pareto curve is better for the young cohorts and the age preference of marriage has declined with the changes of marriage in China.

The shape parameter θ would be positive in the classical

Table 4.1: Estimates of the Parameters in Simple and Generalized Linear Reverse Pareto Curves by Sex and Residence, China, 1987

Cohort	α	β_0	β_1	R^2
Rural Females Aged 35	2.62279	-3.31225	-0.21095	0.99908
Rural Females Aged 50[3]	1.56334	-1.97077		0.99451
Rural Males Aged 35	3.64249	-6.37214	-0.20964	0.99902
Rural Males Aged 50	0.93073	-3.49104	0.34590	0.99841
Urban Females Aged 35	2.36789	-4.01832	-0.12464	0.99910
Urban Females Aged 50[4]	1.82136	-2.28843		0.99716
Urban Males Aged 35	3.15594	-6.66754	-0.07212	0.99949
Urban Males Aged 50	1.08694	-3.94194	0.37963	0.99938

[3]Only the simple reverse Pareto curve is used because of limited number of cases.

[4]Same as Footnote 3.

Table 4.2: Estimates of the Parameters in Generalized Linear Pareto Curve by Sex and Residence, China, 1987

Cohort	θ	β_0	β_1	R^2
Rural Females Aged 35	-5.70206	3.88516	1.04505	0.99967
Rural Females Aged 50	-0.78667	1.05675	0.49627	0.99780
Rural Males Aged 35	-6.17840	4.88456	0.88753	0.99957
Rural Males Aged 50	-4.22452	3.24598	0.71860	0.99916
Urban Females Aged 35	-9.77740	9.62717	1.30345	0.99988
Urban Females Aged 50	-0.89759	0.71152	0.45739	0.99842
Urban Males Aged 35	-14.59472	18.18753	1.51803	0.99985
Urban Males Aged 50	-4.05459	3.37253	0.65101	0.99870

Pareto distribution but the estimates of θ are negative for all cohorts. This is due to the adjusting part added since change of an exponential term is faster than that of a polynomial term.

4.3 Estimates of Parameters in Generalized Logistic Curve

Like Pareto curve, the generalized logistic curve was found to be promising in the study. Table 4.3 shows the estimates of parameters and R-square values. Appendix C gives the results of graduation. The graduation of observed distributions is very good and the closeness of fit is similar to that in the Pareto curve. To avoid repetition, the figures showing how close the fit is are not presented here. One can refer to Appendix C.

It is evident from Table 4.3 that early marriages for young cohorts were fewer than those for old cohorts for both genders in rural and urban areas, since β_0 is smaller for the young cohorts. Also, early marriages occurred more frequently for females than for males. For the old cohorts, rural population would be more likely to have early marriages than urban population. But the values of β_0 for the female young cohorts do not suggest that the risk of first marriage at the starting point for rural population was larger than that for their urban counterparts. This is against empirical findings. The explanation is that this model overestimates early

Table 4.3: Estimates of the Parameters in Generalized Logistic Curve by Sex and Residence, China, 1987

Cohort	β_0	β_1	β_2	β_3	R^2
Rural Females Aged 35	-5.01661	1.54473	-0.15316	0.00712	0.99970
Rural Females Aged 50	-3.56354	1.11655	-0.06397	0.00319	0.99922
Rural Males Aged 35	-5.31604	0.80234	-0.02018	-0.00003	0.99913
Rural Males Aged 50	-4.39311	0.80602	-0.03201	0.00044	0.99810
Urban Females Aged 35	-3.86960	0.57422	-0.00779	-0.00004	0.99777
Urban Females Aged 50	-3.82561	1.08223	-0.06623	0.00142	0.99871
Urban Males Aged 35	-5.05704	0.49148	0.00688	-0.00053	0.99934
Urban Males Aged 50	-4.64149	0.71260	-0.02248	0.00031	0.99859

marriages in urban areas much more than it does in rural places. For example, the expected proportion of marriage at age 15 is 2 percent more than the observed in urban areas while only about one half of 1 percent more in rural areas (see Appendix C).

It is surprising to note that the parameter β_3 for the rural male young cohort and urban young cohorts of both genders does not confirm the mathematical inference of β_3 in Chapter 3 since the values of β_3 for the three cohorts are negative. It indicates the three cohorts had a pattern of late marriage. Since the cohorts are incomplete, the whole declining trend may not have shown up. β_3 for the three cohorts would be positive if more cases showing declining trend were available. The negative value of β_3 may be caused by the late marriage policies. Thus the late tendency suggests that the policies were carried out better in urban areas than in rural areas.

4.4 Estimates of Parameters in Generalized Gompertz Function

The generalized quadratic Gompertz function is utilized to graduate observed nuptiality rates in the study. The results suggest that this function is considerably satisfactory for the study of Chinese nuptiality. The estimates of the parameters are given in Table 4.4. Appendix D shows derived nuptiality rates and deviations from observed

Table 4.4: Estimates of the Parameters in Generalized Gompertz Function by Sex and Residence, China, 1987

Cohort	β_0	β_1	β_2	R^2
Rural Females Aged 35	-4.18554	0.56089	-0.02457	0.90696
Rural Females Aged 50	-3.02905	0.40360	-0.02421	0.91454
Rural Males Aged 35	-6.66021	0.91413	-0.03948	0.94807
Rural Males Aged 50	-4.73417	0.57535	-0.02673	0.93444
Urban Females Aged 35	-5.24136	0.72136	-0.03285	0.94198
Urban Females Aged 50	-3.45274	0.44667	-0.02751	0.92611
Urban Males Aged 35	-7.95180	1.03649	-0.03958	0.94405
Urban Males Aged 50	-5.42823	0.63043	-0.02506	0.95784

ones.

Parameter β_0 in the generalized quadratic Gompertz function reflects the probability of first marriage at the starting point. The smaller β_0, the less the probability of first marriage at the starting point. Let us compare the estimates of β_0 in Table 4.4. The age pattern of first marriage in China have changed with respect to early marriage. The old cohorts had higher chance of early marriage than the young cohorts. Females in general had greater risk of early marriage in comparison to males. The chance of early marriage in rural China was greater than in urban China.

The growth rate β_1 for each data set suggests that the rate of change of nuptiality is faster for the young cohorts than for the old cohorts, for males than for females, and for urban population than for rural population. In addition, since the acceleration rate β_2 is almost the same for all cohorts, the larger β_1 implies that the age pattern of first marriage has shifted to older ages. Thus the young cohorts tended to marry late. So did males and urban population.

4.5 Summary

The three models provide satisfactory fit to the age pattern of first marriage in China. In particular, the empirical results from the piece-wise Pareto and the generalized logistic curve are promising. If the index of

dissimilarity is used as the criterion for a good fit, Pareto curve is slightly better than the generalized logistic curve. However, more parameters are involved in the former. The generalized linear piece-wise Pareto distribution has six parameters and the generalized logistic function four parameters. Thus the generalized logistic model is more parsimonious.

CHAPTER 5

Marriage Trend and Differentials

We have discussed the historical trend and differences by gender and residence in the age pattern of first marriage in China in the preceding chapter. A different approach is discussed in this chapter. Mean age at first marriage is a useful indicator for the analysis. The mean ages at first marriage derived from the piece-wise Pareto and the generalized logistic curve are given in Appendices B and C. The difference between the mean ages from the two model is negligible. The mean ages[5] for the cohorts under study from the generalized logistic model are used here for the comparative study. Moreover, as mentioned in Chapter 1, the gross nuptiality tables is one of the best mechanisms for comparative purposes. The nuptiality tables is based on the derived nuptiality rates from the generalized Gompertz function. In Appendix E, the empirical results are presented.

[5]Since the data are truncated at age 35, the mean age is slightly smaller than that for the cohort completing the marriage experiences but the difference can be negligible because most persons are married at the truncated age.

5.1 Change in Age pattern of Nuptiality

The nuptiality rates or probabilities of entering into first marriage by age, gender and residence are given in Table 5.1. From this table and Figures 5.1 and 5.2, it is clear that the risk of marriage under age 22 had declined sharply from the old to the young cohorts for both males and females in rural and urban China. In other words, early marriage had been reduced dramatically from stage one to stage two in Chinese nuptiality. For females in rural and urban China, the probability curves intersect around age 22 and the probabilities of marriage is lower before the intersection for the young cohorts but higher after the age. There are two intersections of the probability curves for rural males, around ages 22 and 33, and the probabilities are lower outside the two ages but higher in between. The difference after age 33 is quite small. Urban males have the same pattern with the exception of the first intersection, around age 24 instead of age 22 for the rural case. Therefore, increase in the average age at first marriage from stage one to stage two can be expected.

This can be verified from Table 5.2 which presents the mean age at first marriage by gender and residence. In rural China, the mean age for females increased from 19.5 for the cohort aged 50 in 1987 to 20.8 years for the cohort aged 35, and from 22.4 to 23.3 years for males. If urban population is

Table 5.1: Nuptiality Rates by Age:
Selected Cohorts, China, 1987

Age	RFY	RFO	RMY	RMO	UFY	UFO	UMY	UMO
15	.0200	.0588	.0020	.0116	.0075	.0393	.0006	.0060
16	.0334	.0833	.0046	.0196	.0145	.0582	.0015	.0107
17	.0530	.1140	.0098	.0313	.0262	.0814	.0037	.0182
18	.0802	.1476	.0194	.0475	.0442	.1079	.0082	.0293
19	.1154	.1821	.0352	.0681	.0699	.1354	.0168	.0451
20	.1582	.2140	.0592	.0927	.1036	.1607	.0318	.0659
21	.2064	.2396	.0920	.1196	.1436	.1806	.0558	.0917
22	.2565	.2556	.1320	.1462	.1866	.1921	.0903	.1213
23	.3033	.2598	.1751	.1694	.2269	.1933	.1352	.1526
24	.3416	.2516	.2147	.1862	.2584	.1842	.1869	.1825
25	.3662	.2321	.2431	.1939	.2756	.1661	.2388	.2077
26	.3737	.2040	.2545	.1914	.2752	.1418	.2819	.2248
27	.3632	.1708	.2461	.1792	.2574	.1145	.3074	.2314
28	.3360	.1363	.2200	.1589	.2254	.0876	.3097	.2265
29	.2959	.1036	.1817	.1337	.1848	.0634	.2883	.2110
30	.2481	.0750	.1387	.1066	.1419	.0434	.2479	.1868
31	.1981	.0517	.0978	.0805	.1020	.0281	.1970	.1574
32	.1506	.0340	.0638	.0577	.0687	.0173	.1446	.1261
33	.1089	.0213	.0384	.0392	.0433	.0100	.0981	.0961
34	.0751	.0127	.0214	.0252	.0256	.0055	.0615	.0696

Source: Tables E-1 to E-8 in Appendix E.

Note: RFY = rural female young cohort aged 35
RFO = rural female old cohort aged 50
RMY = rural Male young cohort aged 35
RMO = rural Male old cohort aged 50
UFY = urban female young cohort aged 35
UFO = urban female old cohort aged 50
UMY = urban Male young cohort aged 35
UMO = urban Male old cohort aged 50

The same notations are used in the following Table and figures.

Figure 5.1: Probability of Marriage by Sex: Selected Cohorts in Rural China, 1987

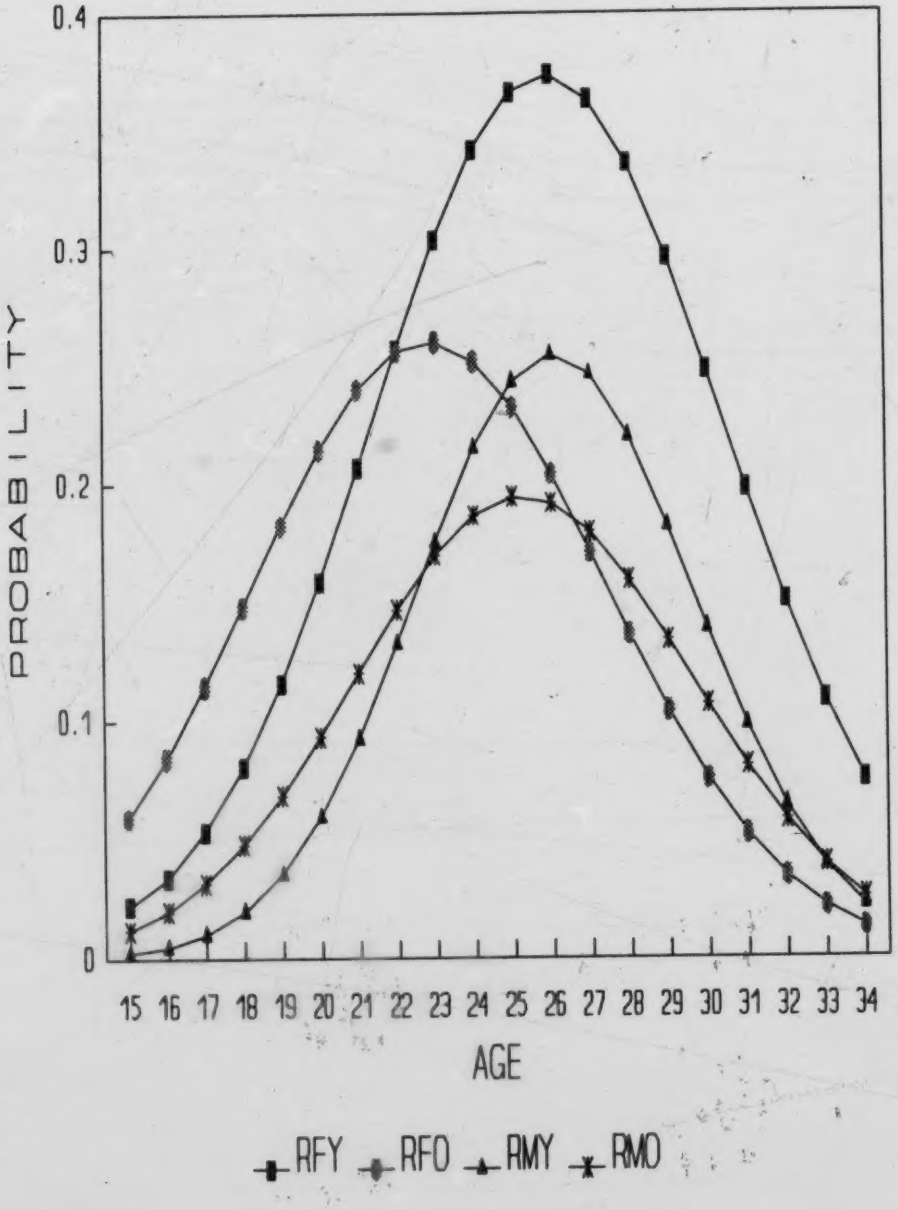


Figure 5.2: Probability of Marriage by Sex: Selected Cohorts in Urban China, 1987

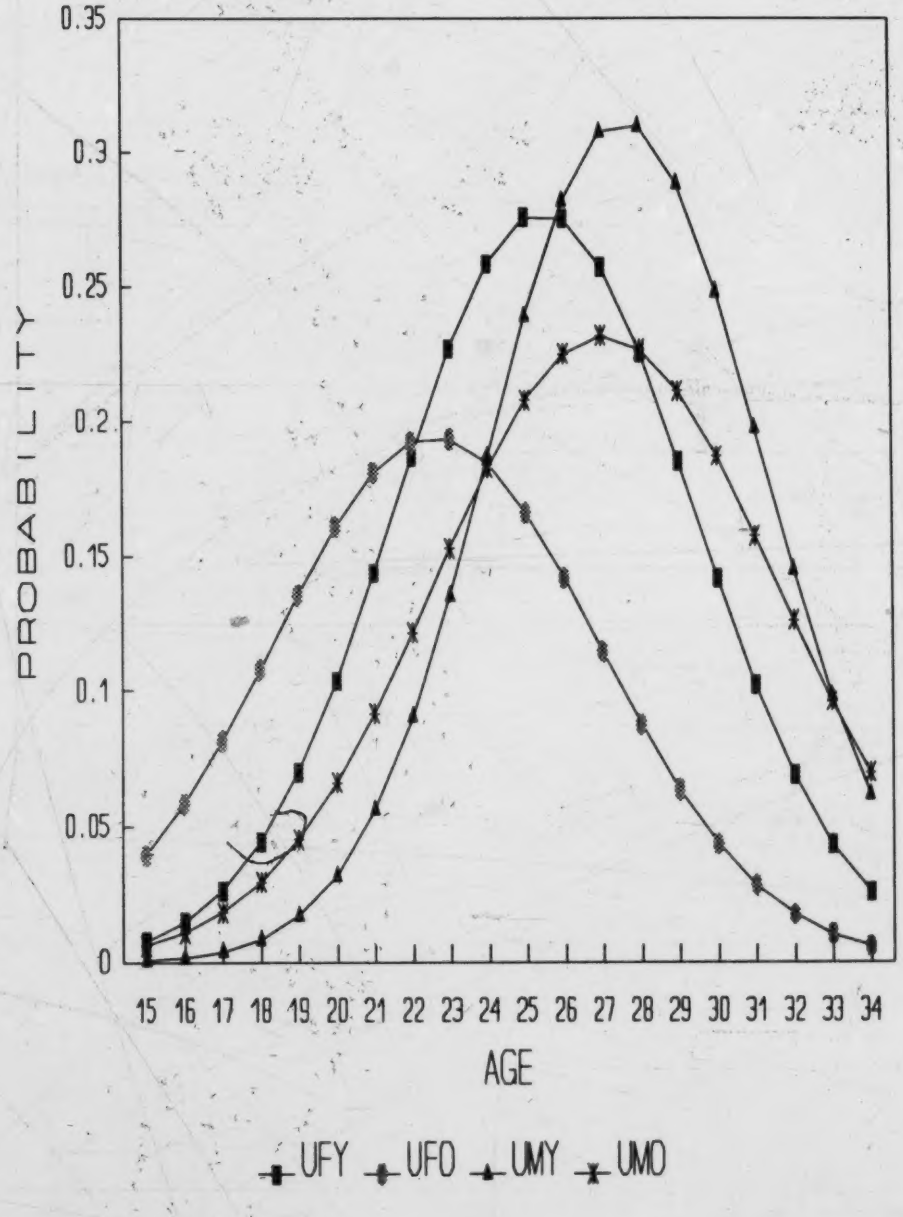


Table 5.2: Mean Age at First Marriage by Sex and Residence Selected Cohorts, China, 1987

Cohort	Mean Age
RFY	20.8
RFO	19.5
RMY	23.3
RMO	22.4
UFY	22.7
UFO	20.2
UMY	24.8
UMO	23.6

Source: Tables C-1 to C-8 in Appendix C.

concerned, the mean age rose from 20.2 to 22.7 years and from 23.6 to 24.8 years for females and males respectively. The increase for females is larger than that for males in both rural and urban China. Compared to rural areas, the amount of change in the mean age is larger in urban areas for both males and females.

From the two figures, we can also see that the spread of the probability curves has become narrowed from the old to young cohorts. The variance of age at first marriage was larger for the old than that for the young cohorts. The first marriage of the old cohorts was more widespread. Thus, age at first marriage was getting closer to the mean age from stage one to stage two.

Several explanations can be advanced for the changes in the age pattern of first marriage in China. First, social and economic development such as growth of education, urbanization, female labour participation and social status made these changes possible. Secondly, the traditional values of marriage got demphasised as time passed. Thirdly, with the political movement of *"Shang Shan Xia Xiang"* in the late 1960s (which implies that educated youths had to go to the countryside and mountain areas to receive re-education from peasants during the Cultural Revolution period: 1966-1976), most graduates from junior and senior high schools went to and worked in the countryside and mountain areas, and hence their marriages got delayed. Finally, the policy of encouraging late

marriage since the 1970s may have been a key factor behind the changes.

The age pattern of first marriage in stage one which is characterized by early entry into wedlock is similar to that in many less developed countries. The pattern in stage two which is late marriage is similar to that in developed countries. Bogue (1969) has point out: "A low level of literacy and a low level of industrial development tend to be associated with early marriage. A high level of industrialization and literacy have tended to be associated with late marriage." The Chinese situation is different. As pointed out in the discussion, the marriage policy of the government is the major cause of late marriage in China. If the force of the government policy is removed, the mean age at first marriage will decline to some extent.

5.2 Gender and Residence Differentials in Chinese Nuptiality

5.2.1 Gender Differentials

Table 5.1 and Figures 5.1 and 5.2 also suggest that gender differences do exist in Chinese marriage. For the rural female and male old cohorts in this study, nuptiality rates were higher for females before age 27 but higher for males after the age. The gender difference before age 27 was much greater than that after age 27. If we look at the young

cohorts for both genders in rural areas, the pattern seems to have changed. The marriage probabilities were higher for females than for males at all ages. In urban China, females had greater chance of marriage than males by age 24 but smaller after the age for the old cohorts. The young cohorts had the same pattern except that the two probability curves intersect around 26.

The gender difference in the mean age at first marriage is 2.5 years for the young and 2.9 years for the old cohort in rural residence. This difference in urban areas is 2.1 and 3.4 years for the young and the old cohorts respectively. An interesting finding is that the female-male mean age difference was getting smaller and tending to be 2 years with the changes from stage one to stage two. Therefore, we may conclude that males tend to get married two years later than females, which coincides with the difference of the minimum age of marriage by law. Obviously, the gender differentials are caused by the marriage law. Moreover, according to Chinese traditions, grooms and their families are responsible for almost all wedding expenses which are usually very high. Most males can not afford those expenses when they are young. Thus they have to delay their marriage.

5.2.2 Rural and Urban Differentials

Figures 5.3 and 5.4, present a clear picture of the

Figure 5.3: Probability of Marriage by Residence:
Selected Female Cohorts, China, 1987

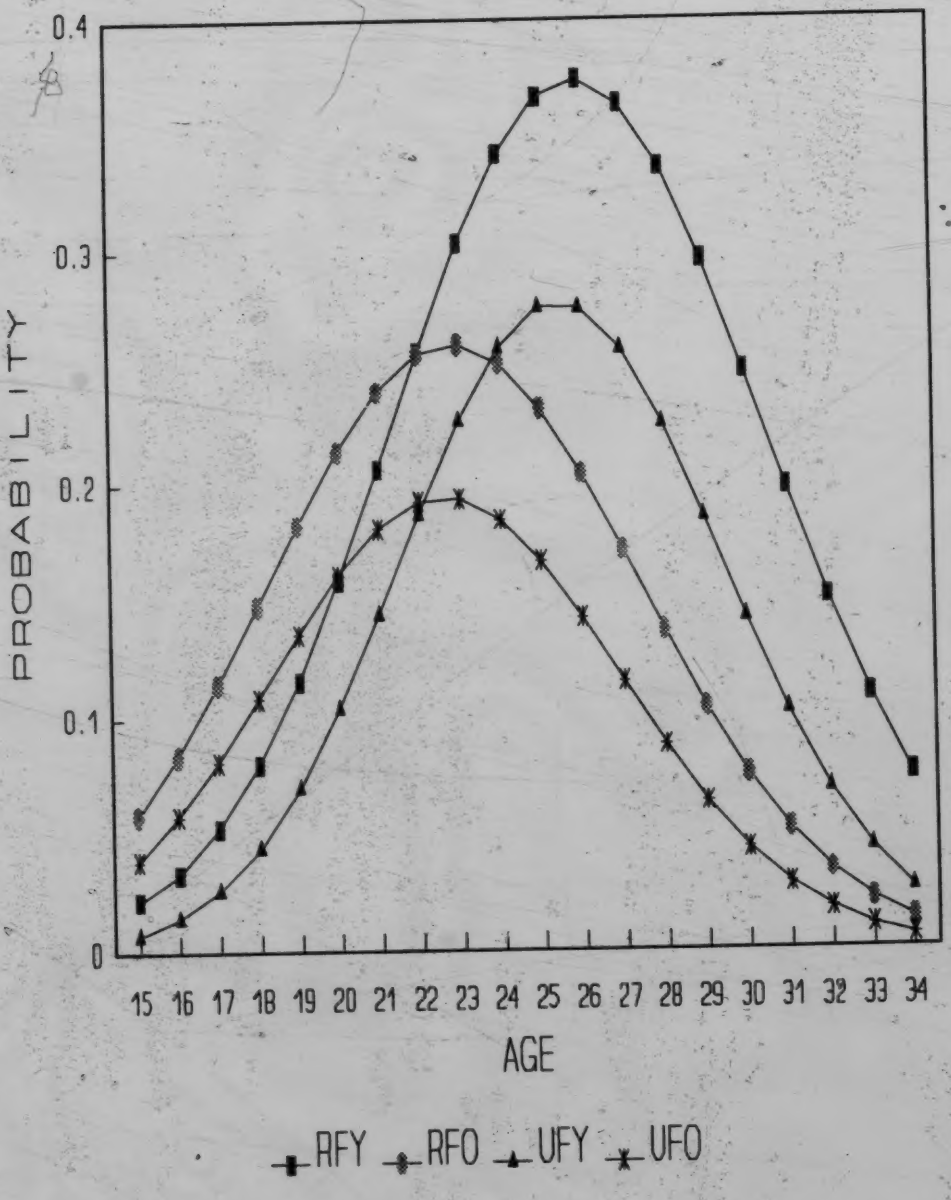
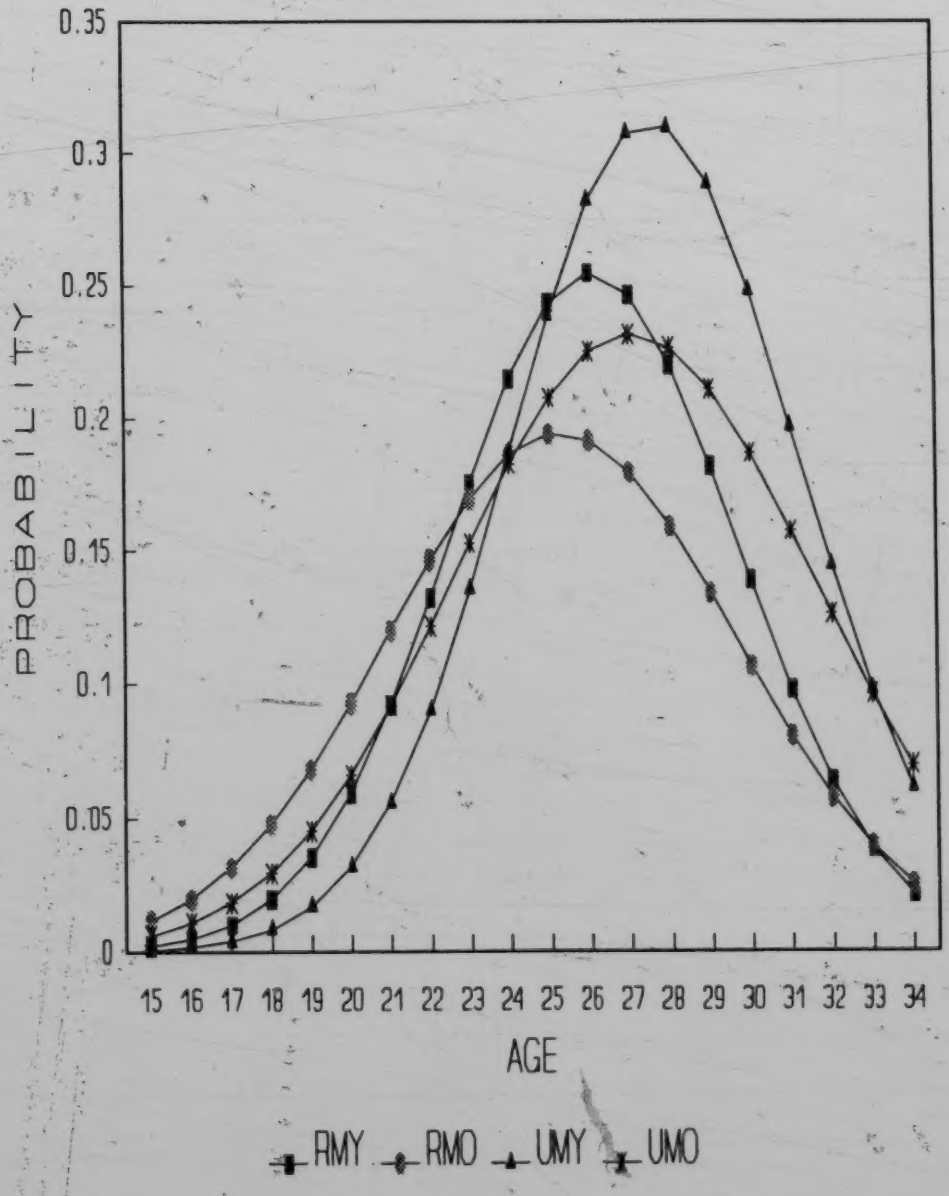


Figure 5.4: Probability of Marriage by Residence:
Selected Male Cohorts, China, 1987



rural-urban differentials in marriage. For females, both the old and young cohorts in rural areas had higher marriage probabilities than their urban counterparts at all ages. This difference may be due to differential changes in cultural, social and economic development. For example, urban females have less traditional pressures if they remain unmarried. They have higher education and social status, and more social and economic independence. Thus urban females would be more likely to remain single.

As far as males are concerned, the differential is not similar to that of females. Compared to their urban counterparts, rural males in general marry earlier since they have higher nuptiality rates at young ages and lower at old ages. The age at the intersection of the curves has changed from 24 for the old cohorts to 25 for the young cohorts. Dominant traditional resistance to late marriage policies and social pressures on marriage in rural areas can explain the difference partially.

The mean age at first marriage also shows that rural population had the tendency to marry earlier than urban population. The rural-urban differences in the mean age are 1.9 years and 0.7 years for females, 1.5 years and 1.2 years for males for the young and old cohorts, respectively. With changes of age pattern of first marriage from stage one to stage two, the gap in the mean age has enlarged, especially for females. The most important explanation may be that late

marriage policies are implemented better in urban than in rural China.

5.3 Eventual Marriage

The column, PM_x, in the nuptiality table describes the probability of eventual marriage at age x during lifetime before reaching the end of the table. At age 15, the young cohorts under study had higher chance of eventual marriage than their corresponding old cohorts. Consequently, one may conclude that with the marriage changes, probability of eventual marriage has increased. However, this may not be true. We may remember the rampancy of child and early teenage marriage in prerevolutionary China (see Chapter 2) and the assumption of no marriage before age 15. The old cohorts aged 50 in 1987 were aged 12 already in 1949 when the People's Republic was founded and traditional customs still played an important role in the marriage system in the early years of revolutionary China. Therefore, many cases of marriage before age 15 for the old cohorts have been missed in the data set. The chance of eventual marriage of the old cohorts would increase quite a bit if marriages before age 15 had been taken into account in the analysis.

For the young cohorts, marriages before age 15 were few and negligible. Rural females had higher percentage of eventual marriage at age 15 than rural males. The interesting

finding is for urban China. The percentage of eventual marriage at age 15 for urban females was slightly lower than that for urban males. Still among the young cohort, the percentage for rural females were higher than that for urban females but for rural males lower than their urban counterparts.

5.4 Expectation of Single Life

The last column in the nuptiality tables gives the number of years a person has to spend at single status at each age. It is clear from Appendix E that as age increases, the single life expectancy decreases first, then increases, and finally decreases again for all cohorts except the urban male old cohort. For this cohort, the single life expectancy decreases all time. In the age bracket 15-18, the number of years of single life moved up from the old to the young cohorts for females in both rural and urban China, and declined until age around 20, then went down up to age 30, and converged after age 30.

5.5 Conclusions and Implications

The age pattern of Chinese nuptiality has changed greatly from stage one to stage two. In light of the discussions above and in the preceding chapter, several conclusions can be

drawn.

1. Child and early marriages have declined sharply for both genders in rural and urban China, and as a consequence, the mean age at first marriage has jumped up. But the probability of eventual marriage still remains high, especially for females. The variation of age at first marriage has become small from stage one to stage two.

2. Males tend to marry later than females, and have smaller chances of early marriage in both rural and urban areas. The difference in the mean age between females and males has narrowed down. This difference has approached 2 years which coincides with the difference required by the minimum legal age of marriage between the genders.Among the young cohorts, the probability of eventual marriage is higher for rural females and urban males than for rural males and urban females, which suggests that the chance of eventual marriage has changed.

3. In spite of decline of early marriage, rural population still tends to marry earlier than their urban counterparts. The mean age difference between rural and urban folks has increased, particularly for females.

Some implications can be drawn from the findings in the study. First, since the age at first marriage has been delayed from stage one to stage two of marriage, the exposure years to intercourse and potential pregnancy within marriage have declined (Laing and Krishnan, 1976) in China. Therefore the

marital fertility is likely to decrease, holding other factors unchanged. The national One-per-Thousand Fertility Survey and other fertility surveys have confirmed this implication. Second, the changed pattern of the probability of eventual marriage implies a possibility that inter-regional marriages between rural females and urban males may have been increasing. If this is true, more females may migrate to urban areas. Thus the growth of urban population is likely to increase, ceteris paribus. In addition, rural males may lose their potential mates for marriage. However, since migration from rural to urban areas is controlled strictly, this may not be a serious issue. Third, a higher degree of early marriage in rural China implies that late marriage policy has been carried out better in urban China. If Chinese government hopes to control fertility further in China, the emphasis on late marriage should be put in the rural areas, since most population lives in the rural places.

CHAPTER 6

Summary

In this chapter, a summary of the work done is presented and suggestions of further research are discussed.

6.1 Summary

The age patterns of first marriage vary from nation to nation. Within a country, the patterns also differ according to cultural, socio-economic, political and legal factors. Despite variations in marriage, the risk of marriage increases at first, reaches a maximum, and then decreases approaching zero as age increases.

The major purpose of this study has been to formulate and apply mathematical models to Chinese marriage. With the theoretical rationale as the guide, three models are developed and used to investigate age distributions of marriage in China. Complete and incomplete cohort data from a national survey are used to test the models. Piece-wise Pareto and generalized logistic curves yielded promising results but the former is complicated. The higher the degree of polynomial in the generalized Gompertz function, the more parameters to be estimated; while the fit improves considerably, the

interpretation becomes harder. Generally speaking, the interpretation is not easy with a degree higher than two in a polynomial. Various types of Pearson type distributions have been tried with no satisfactory results.

Analyses of marriage trend, and gender and rural-urban differentials in marriage are another purpose of this study. China has experienced a shift in its marriage patterns from early to late marriage. The mean age at first marriage has increased and the variance decreased from stage one to stage two. The gender differences in the age pattern of first marriage, on an average, have narrowed; but the rural-urban differences enlarged.

6.2 Suggestions for Further Studies

In the study of trend of age pattern of Chinese nuptiality, problems of using real cohort data are that the cohort have not finished their marriage yet, and hence it is difficult to analyze the more recent trend. To solve the problems, census data or period data can be employed as a hypothetically complete cohort. For example, one may use 1964 and 1982 census data to investigate the marriage trend.

The decline in trend of marriage probabilities is not very clear in the generalized logistic model for the female and male young cohorts in urban China and the rural male young cohort. This is because these cohorts had a considerably late

marriage and have not yet completed their marriage experiences at the survey time. More recent data are needed to see the decline in trend.

Since one-year age data of first marriage modulate with time, five-year age group data can be used to avoid the fluctuations. In such a case, Pearson type distributions may be helpful for the study of marriage, especially Type I and Type III distributions.

The hazard rate or the force of marriage attraction gives a useful initial idea to formulate a model for the age pattern of marriage. For example, h(x) can be taken to increase first and then decrease. With this format, one can obtain the probability distribution of marriage. This idea can be applied to mortality, fertility and migration study as well.

Finally, model marriage tables or nuptiality tables by gender and residence in China could be derived from this study if more cohorts are analyzed. Some work of this type is planned for the future.

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APPENDIX A

Age Distribution of First Marriage by Sex and Residence

Table A-1: Age Distribution of First Marriage: Female Cohort Aged 35 in Rural China, 1987

Age	Frequency	Age-specific Marriage Rate (%)
15	473	0.94
16	1646	3.31
17	3603	7.50
18	6592	14.84
19	6204	16.40
20	7142	22.58
21	5396	22.03
22	4957	25.96
23	4550	32.19
24	3614	37.70
25	2622	43.90
26	1381	41.22
27	815	41.39
28	467	40.47
29	218	31.73
30	114	24.31
31	57	16.06
32	42	14.09
33	35	13.67
34	25	11.31

Total Population = 50149

Table A-2: Age Distribution of First Marriage: Female Cohort Aged 50 in Rural China, 1987

Age	Frequency	Age-specific Marriage Rate (%)
15	1019	3.71
16	2106	7.97
17	3322	13.65
18	5136	24.45
19	3845	24.23
20	4364	36.29
21	1946	25.39
22	1486	25.99
23	1033	24.42
24	928	29.02
25	733	32.29
26	409	26.61
27	194	17.20
28	125	13.38
29	69	8.53
30	62	8.38
31	22	3.24
32	17	2.59
33	15	2.35
34	14	2.24

Total Population = 27455

Table A-3: Age Distribution of First Marriage: Male Cohort Aged 35 in Rural China,1987

Age	Frequency	Age-specific Marriage Rate (%)
15	47	0.09
16	197	0.38
17	631	1.23
18	1696	3.35
19	2568	5.24
20	5494	11.83
21	4264	10.42
22	5136	14.01
23	5152	16.34
24	5545	21.02
25	5843	28.05
26	3426	22.86
27	2386	20.63
28	1944	21.18
29	1013	14.00
30	854	13.73
31	437	8.14
32	389	7.89
33	263	5.79
34	104	2.43

Total Population = 51563

Table A-4: Age Distribution of First Marriage: Male Cohort Aged 50 in Rural China,1987

Age	Frequency	Age-specific Marriage Rate (%)
15	292	0.97
16	447	1.51
17	814	2.78
18	2039	7.17
19	2276	8.63
20	4346	18.03
21	2274	11.51
22	2463	14.08
23	2304	15.33
24	2534	19.92
25	2469	24.23
26	1661	21.52
27	987	16.29
28	844	16.64
29	453	10.72
30	502	13.30
31	210	6.42
32	183	5.98
33	122	4.24
34	89	3.23

Total Population = 29977

Table A-5: Age Distribution of First Marriage: Female Cohort Aged 35 in Urban China,1987

Age	Frequency	Age-specific Marriage Rate (%)
15	135	0.41
16	527	1.59
17	1257	3.86
18	2561	8.18
19	2649	9.22
20	2999	11.50
21	2709	11.73
22	2960	14.53
23	3512	20.16
24	3429	24.66
25	3330	31.79
26	2244	31.40
27	1552	31.66
28	1022	30.51
29	551	23.67
30	323	18.18
31	145	9.97
32	73	5.58
33	49	3.96
34	37	3.12

Total Population = 33214

Table A-6: Age Distribution of First Marriage: Female Cohort Aged 50 in Urban China, 1987

Age	Frequency	Age-specific Marriage Rate (%)
15	397	2.03
16	1012	5.29
17	1949	10.75
18	3081	19.04
19	2531	19.32
20	2920	27.63
21	1492	19.50
22	1185	19.24
23	947	19.04
24	747	18.55
25	689	21.01
26	399	15.41
27	221	10.09
28	163	8.27
29	108	5.97
30	67	3.94
31	29	1.78
32	25	1.56
33	17	1.08
34	15	0.96

Total Population = 19540

Table A-7: Age Distribution of First Marriage: Male Cohort Aged 35 in Urban China,1987

Age	Frequency	Age-specific Marriage Rate (%)
15	5	0.01
16	51	0.15
17	230	0.69
18	539	1.62
19	927	2.83
20	2017	6.35
21	1846	6.20
22	2444	8.75
23	2871	11.27
24	3656	16.18
25	4186	22.10
26	3420	23.17
27	3137	27.67
28	2575	31.39
29	1727	30.69
30	1082	27.74
31	475	16.86
32	348	14.85
33	252	12.63
34	167	9.58

Total Population = 33531

Table A-8: Age Distribution of First Marriage: Male Cohort Aged 50 in Urban China, 1987

Age	Frequency	Age-specific Marriage Rate (%)
15	89	0.45
16	157	0.80
17	337	1.74
18	829	4.34
19	1143	6.26
20	2149	12.56
21	1418	9.48
22	1641	12.12
23	1573	13.22
24	1844	17.85
25	2053	24.20
26	1574	24.48
27	1002	20.63
28	816	21.17
29	590	19.41
30	571	23.32
31	293	15.60
32	215	13.56
33	177	12.92
34	90	7.54

Total Population = 19664

APPENDIX B

Fit of Piece-wise Pareto Distribution by Age, Sex and Residence

Table B-1: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Female Cohort Aged 35 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	1.84	0.53	1.31	0.95	0.27	0.67
16	8.26	7.69	0.57	3.30	3.68	-0.38
17	22.30	23.78	-1.48	7.21	8.26	-1.05
18	47.99	46.54	1.45	13.20	11.69	1.50
19	72.17	72.86	-0.69	12.42	13.52	-1.10
20	100.00	99.87	0.13	14.30	13.88	0.42
21	100.00	99.51	0.49	10.80	9.91	0.89
22	77.79	79.14	-1.35	9.92	10.86	-0.93
23	57.38	56.82	0.57	9.11	9.31	-0.20
24	38.65	37.68	0.98	7.23	6.92	0.31
25	23.78	23.44	0.33	5.25	4.67	0.58
26	12.98	13.85	-0.87	2.76	2.92	-0.16
27	7.30	7.84	-0.54	1.63	1.73	-0.10
28	3.94	4.27	-0.33	0.93	0.98	-0.04
29	2.02	2.26	-0.24	0.44	0.53	-0.01
30	1.12	1.16	-0.04	0.23	0.28	-0.05
31	0.65	0.58	0.07	0.11	0.14	-0.03
32	0.42	0.29	0.13	0.08	0.07	0.01
33	0.25	0.14	0.11	0.07	0.04	0.03
34	0.10	0.07	0.04	0.05	0.02	0.03
Total				100.00	99.68	

The mean for observed data = 20.80365

The mean for expected data = 20.81328

Index of dissimilarity between obs. & ex. prop. = 4.46963

Table B-2: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Female Cohort Aged 50 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	8.80	4.72	4.08	3.80	2.03	1.76
16	26.98	26.27	0.71	7.85	9.30	-1.45
17	55.66	58.37	-2.72	12.37	13.85	-1.48
18	100.00	98.78	1.22	19.13	17.43	1.70
19	100.00	100.68	-0.68	14.32	16.43	-2.11
20	74.81	71.77	3.03	16.26	12.47	3.78
21	46.21	49.83	-3.62	7.25	9.03	-1.78
22	33.46	33.95	-0.49	5.54	6.34	-0.80
23	23.73	22.81	0.92	3.85	4.35	-0.50
24	16.96	15.16	1.80	3.46	2.94	0.52
25	10.88	9.98	0.89	2.73	1.96	0.77
26	6.07	6.53	-0.45	1.52	1.30	0.22
27	3.39	4.24	-0.85	0.72	0.85	-0.13
28	2.12	2.74	-0.62	0.47	0.56	-0.09
29	1.30	1.77	-0.46	0.26	0.36	-0.10
30	0.85	1.13	-0.28	0.23	0.23	-0.00
31	0.45	0.73	-0.28	0.08	0.15	-0.07
32	0.30	0.46	-0.16	0.06	0.10	0.03
33	0.19	0.29	-0.10	0.06	0.06	0.01
34	0.09	0.19	-0.09	0.05	0.04	0.01
Total				100.00	99.79	

The mean for observed data = 19.42938

The mean for expected data = 19.43887

Index of dissimilarity between obs. & ex. prop. = 8.76203

Table B-3: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Male Cohort Aged 35 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.13	0.01	0.12	0.10	0.01	0.09
16	0.67	0.55	0.12	0.42	0.41	0.00
17	2.39	2.85	-0.46	1.33	1.78	-0.44
18	7.03	7.87	-0.84	3.58	3.87	-0.29
19	14.05	15.93	-1.88	5.42	6.22	-0.81
20	29.07	26.83	2.24	11.59	8.41	3.18
21	40.73	39.98	0.75	9.00	10.15	-1.15
22	54.78	54.60	0.18	10.84	11.28	-0.44
23	68.86	69.85	-0.98	10.87	11.77	-0.90
24	84.02	84.93	-0.90	11.70	11.64	0.06
25	100.00	99.16	0.84	12.33	10.98	1.35
26	100.00	99.86	0.14	7.23	7.09	0.14
27	68.32	68.81	-0.49	5.03	5.30	-0.27
28	46.26	45.58	0.69	4.10	3.74	0.36
29	28.29	29.18	-0.88	2.14	2.52	-0.38
30	18.93	18.13	0.79	1.80	1.63	0.17
31	11.03	10.99	0.04	0.92	1.02	-0.10
32	6.99	6.51	0.48	0.82	0.62	0.20
33	3.39	3.77	-0.38	0.55	0.37	0.18
34	0.96	2.15	-1.19	0.22	0.22	0.00
Total				100.00	99.04	

The mean for observed data = 23.31992

The mean for expected data = 23.26764

Index of dissimilarity between obs. & ex. prop. = 5.74233

Table B-4: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Male Cohort Aged 50 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	2.86	1.90	0.96	1.07	0.71	0.36
16	7.24	7.47	-0.23	1.64	2.08	-0.44
17	15.20	16.97	-1.77	2.98	3.56	-0.58
18	35.17	32.81	2.36	7.47	5.92	1.54
19	57.45	58.59	-1.14	8.33	9.64	-1.31
20	100.00	99.81	0.19	15.91	15.42	0.50
21	100.00	99.06	0.94	8.33	6.68	1.64
22	86.70	88.39	-1.69	9.02	9.57	-0.55
23	72.29	73.10	-0.81	8.44	10.08	-1.64
24	58.81	57.01	1.81	9.28	9.14	0.14
25	43.99	42.41	1.58	9.04	7.54	1.50
26	29.55	30.36	-0.81	6.08	5.83	0.25
27	19.83	21.05	-1.22	3.61	4.29	-0.67
28	14.06	14.20	-0.14	3.09	3.03	0.06
29	9.12	9.36	-0.24	1.66	2.07	-0.42
30	6.47	6.05	0.42	1.84	1.38	0.46
31	3.53	3.84	-0.31	0.77	0.90	-0.13
32	2.30	2.40	-0.09	0.67	0.58	0.09
33	1.23	1.48	-0.24	0.45	0.36	0.08
34	0.52	0.90	-0.38	0.33	0.22	0.10
Total				100.00	99.00	

The mean for observed data = 22.36592

The mean for expected data = 22.34999

Index of dissimilarity between obs. & ex. prop. = 6.73181

Table B-5: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Female Cohort Aged 35 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.70	0.33	0.37	0.42	0.20	0.22
16	3.43	3.90	-0.47	1.64	2.15	-0.51
17	9.94	11.53	-1.59	3.92	6.65	-0.68
18	23.20	22.58	0.62	7.99	8.17	1.33
19	36.92	36.14	0.78	8.26	9.14	0.09
20	52.45	51.31	1.14	9.35	9.62	0.22
21	66.48	67.28	-0.80	8.45	9.68	-1.17
22	81.81	83.35	-1.54	9.23	9.40	-0.45
23	100.00	98.97	1.03	10.95	11.06	1.55
24	100.00	100.19	-0.19	10.69	9.76	-0.36
25	73.12	72.40	0.72	10.39	7.35	0.62
26	47.01	47.86	-0.85	7.00	4.95	-0.35
27	29.42	29.37	0.05	4.84	3.06	-0.11
28	17.25	16.93	0.32	3.19	1.76	0.13
29	9.24	9.25	-0.01	1.72	0.96	-0.04
30	4.92	4.82	0.10	1.01	0.50	0.05
31	2.38	2.41	-0.03	0.45	0.25	-0.04
32	1.25	1.16	0.08	0.23	0.12	-0.02
33	0.67	0.54	0.13	0.15	0.05	0.03
34	0.29	0.25	0.04	0.12	0.02	0.06
Total				100.00	99.41	

The mean for observed data = 22.48019

The mean for expected data = 22.46182

Index of dissimilarity between obs. & ex. prop. = 4.31496

Table B-6: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Female Cohort Aged 50 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	6.17	2.87	3.30	2.21	1.03	1.18
16	21.88	21.23	0.66	5.62	6.57	-0.94
17	52.15	53.82	-1.67	10.83	11.66	-0.83
18	100.00	99.33	0.67	17.12	16.29	0.84
19	100.00	100.33	-0.33	14.07	15.60	-1.54
20	78.10	76.04	2.06	16.23	12.92	3.30
21	52.83	55.91	-3.09	8.29	10.06	-1.77
22	39.91	40.24	-0.33	6.59	7.54	-0.95
23	29.66	28.50	1.16	5.26	5.50	-0.24
24	21.46	19.93	1.53	4.15	3.94	0.21
25	15.00	13.80	1.20	3.83	2.78	1.50
26	9.03	9.48	-0.44	2.22	1.93	0.28
27	5.58	6.46	-0.88	1.23	1.34	-0.11
28	3.67	4.38	-0.72	0.91	0.92	-0.01
29	2.26	2.96	-0.70	0.60	0.62	-0.02
30	1.32	1.99	-0.66	0.37	0.42	-0.05
31	0.74	1.33	-0.59	0.16	0.28	-0.12
32	0.49	0.89	-0.39	0.14	0.19	-0.05
33	0.28	0.59	-0.31	0.09	0.13	-0.03
34	0.13	0.39	-0.26	0.08	0.09	0.00
Total				100.00	99.81	

The mean for observed data = 20.02779

The mean for expected data = 20.03090

Index of dissimilarity between obs. & ex. prop. = 6.87071

Table B-7: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Male Cohort Aged 35 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.03	0.01	0.01	0.02	0.01	0.01
16	0.30	0.42	-0.11	0.16	0.23	-0.07
17	1.52	1.91	-0.39	0.72	0.88	-0.16
18	4.39	5.15	-0.75	1.69	1.90	-0.21
19	9.33	10.59	-1.26	2.90	3.20	-0.29
20	20.08	18.56	1.52	6.31	4.68	1.63
21	29.91	29.26	0.65	5.78	6.28	-0.51
22	42.93	42.76	0.17	7.65	7.93	-0.28
23	58.22	59.06	-0.83	8.98	9.57	-0.59
24	77.70	78.05	-0.35	11.44	11.16	0.28
25	100.00	99.60	0.40	13.10	12.66	0.44
26	100.00	100.06	-0.06	10.70	10.73	-0.03
27	74.06	74.04	0.02	9.82	9.96	-0.15
28	50.26	49.89	0.37	8.06	7.78	0.27
29	30.73	31.02	-0.29	5.40	5.38	0.03
30	17.63	17.99	-0.37	3.39	3.37	0.01
31	9.42	9.82	-0.40	1.49	1.96	-0.47
32	5.82	5.08	0.74	1.09	1.06	0.03
33	3.18	2.50	0.67	0.79	0.55	0.24
34	1.27	1.18	0.08	0.52	0.27	0.26
Total				100.00	99.56	

The mean for observed data = 24.77026

The mean for expected data = 24.73810

Index of dissimilarity between obs. & ex. prop. = 3.20679

Table B-8: Fit of Piece-wise Pareto Curve to Proportions of First Marriage: Male Cohort Aged 50 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	1.89	1.10	0.79	0.48	0.28	0.20
16	5.23	5.33	-0.10	0.85	1.07	-0.23
17	12.39	13.58	-1.18	1.82	2.09	-0.27
18	30.02	28.61	1.41	4.47	3.81	0.66
19	54.32	54.95	-0.63	6.16	6.68	-0.52
20	100.00	99.90	0.10	11.58	11.39	0.19
21	100.00	98.54	1.46	7.64	5.03	2.61
22	89.77	91.81	-2.04	8.84	9.16	-0.32
23	77.92	79.53	-1.61	8.47	10.76	-2.29
24	66.57	65.11	1.46	9.93	10.57	-0.64
25	53.27	50.95	2.31	11.06	9.35	1.71
26	38.45	38.43	0.02	8.48	7.71	0.77
27	27.09	28.10	-1.01	5.40	6.03	-0.63
28	19.86	20.02	-0.16	4.40	4.53	-0.14
29	13.97	13.95	0.02	3.18	3.30	-0.12
30	9.71	9.54	0.18	3.08	2.33	0.74
31	5.59	6.41	-0.81	1.58	1.62	-0.04
32	3.48	4.24	-0.76	1.16	1.10	0.06
33	1.93	2.77	-0.84	0.95	0.73	0.22
34	0.65	1.79	-1.14	0.48	0.48	0.00
Total				100.00	98.03	

The mean for observed data = 23.53133

The mean for expected data = 23.50345

Index of dissimilarity between obs. & ex. prop. = 7.15970

APPENDIX C

Graduation by Generalized Logistic Curve

by Age, Sex and Residence

Table C-1: Generalized Logistic Graduation of Proportions of First Marriage by Age: Female Cohort Aged 35 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.94	1.36	-0.42	0.94	1.36	-0.42
16	4.23	4.65	-0.43	3.28	3.29	-0.01
17	11.41	11.91	-0.50	7.18	7.26	-0.08
18	24.55	23.49	1.06	13.14	11.58	1.56
19	36.93	37.34	-0.41	12.37	13.85	-1.48
20	51.17	50.79	0.38	14.24	13.45	0.79
21	61.93	62.47	-0.54	10.76	11.68	-0.92
22	71.81	72.30	-0.48	9.88	9.82	0.06
23	80.89	80.58	0.30	9.07	8.29	0.79
24	88.09	87.48	0.61	7.21	6.90	0.31
25	93.32	92.85	0.47	5.23	5.38	-0.15
26	96.07	96.54	-0.46	2.75	3.68	-0.93
27	97.70	98.63	-0.93	1.63	2.09	-0.48
28	98.63	99.57	-0.94	0.93	0.94	-0.01
29	99.06	99.90	-0.83	0.43	0.33	0.11
30	99.29	99.98	-0.69	0.23	0.08	0.14
31	99.41	100.00	-0.59	0.11	0.02	0.10
32	99.49	100.00	-0.51	0.08	0.00	0.08
33	99.56	100.00	-0.44	0.07	0.00	0.07
34	99.61	100.00	-0.39	0.05	0.00	0.05

The mean for observed data = 20.80365

The mean for expected data = 20.80153

Index of dissimilarity for cumulative prop. = 2.82635

Index of dissimilarity for actual prop. = 4.06959

Table C-2: Generalized Logistic Graduation of Proportions of First Marriage by Age Female Cohort Aged 50 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	3.71	4.65	-0.94	3.71	4.65	-0.94
16	11.38	11.63	-0.25	7.67	6.98	0.69
17	23.48	24.04	-0.56	12.10	12.41	-0.32
18	42.19	40.62	1.57	18.71	16.58	2.13
19	56.19	57.26	-1.06	14.00	16.64	-2.63
20	72.09	70.56	1.53	15.90	13.30	2.60
21	79.18	79.80	-0.62	7.09	9.24	-2.15
22	84.59	85.81	-1.22	5.41	6.01	-0.60
23	88.35	89.66	-1.31	3.76	3.85	-0.09
24	91.73	92.16	-0.43	3.38	2.50	0.88
25	94.40	93.82	0.59	2.67	1.66	1.01
26	95.89	94.95	0.94	1.49	1.14	0.35
27	96.60	95.76	0.84	0.71	0.81	-0.10
28	97.05	96.36	0.69	0.46	0.60	-0.15
29	97.30	96.84	0.47	0.25	0.47	-0.22
30	97.53	97.23	0.30	0.23	0.40	-0.17
31	97.61	97.58	0.03	0.08	0.35	-0.27
32	97.67	97.91	-0.24	0.06	0.33	-0.27
33	97.72	98.23	-0.50	0.05	0.32	-0.26
34	97.78	98.54	-0.76	0.05	0.31	-0.26

The mean for observed data = 19.42938

The mean for expected data = 19.53952

Index of dissimilarity for cumulative prop. = 6.94133

Index of dissimilarity for actual prop. = 7.66392

Table C-3: Generalized Logistic Graduation of Proportions of First Marriage by Age: Male Cohort Aged 35 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.09	0.72	-0.63	0.09	0.72	-0.63
16	0.47	1.54	-1.07	0.38	0.82	-0.43
17	1.70	3.12	-1.42	1.22	1.58	-0.35
18	4.99	5.97	-0.99	3.29	2.86	0.43
19	9.97	10.75	-0.78	4.98	4.77	0.21
20	20.62	17.96	2.66	10.66	7.22	3.44
21	28.89	27.65	1.24	8.27	9.68	-1.41
22	38.95	39.01	-0.16	9.96	11.36	-1.40
23	48.84	50.66	-1.82	9.99	11.65	-1.66
24	59.60	61.25	-1.66	10.75	10.59	0.16
25	70.93	70.00	0.93	11.33	8.75	2.59
26	77.57	76.75	0.82	6.64	6.75	-0.11
27	82.20	81.74	0.46	4.63	4.99	-0.36
28	85.97	85.32	0.65	3.77	3.59	0.18
29	87.94	87.86	0.08	1.96	2.53	-0.57
30	89.59	89.61	-0.02	1.66	1.75	-0.10
31	90.44	90.78	-0.34	0.85	1.17	-0.32
32	91.19	91.50	-0.30	0.75	0.72	0.04
33	91.70	91.84	-0.14	0.51	0.35	0.17
34	91.91	91.85	-0.05	0.20	0.01	0.19

The mean for observed data = 23.31992

The mean for expected data = 23.28677

Index of dissimilarity for cumulative prop. = 6.89219

Index of dissimilarity for actual prop. = 7.40301

Table C-4: Generalized Logistic Graduation of Proportions of First Marriage by Age: Male Cohort Aged 50 in Rural China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.97	1.80	-0.83	0.97	1.80	-0.83
16	2.47	3.72	-1.25	1.49	1.91	-0.42
17	5.18	7.10	-1.92	2.72	3.38	-0.67
18	11.98	12.51	-0.52	6.80	5.40	1.40
19	19.58	20.19	-0.62	7.59	7.69	-0.09
20	34.07	29.83	4.24	14.50	9.64	4.86
21	41.66	40.46	1.19	7.59	10.64	-3.05
22	49.87	50.91	-1.03	8.22	10.44	-2.23
23	57.56	60.21	-2.65	7.69	9.34	-1.62
24	66.01	67.93	-1.92	8.45	7.72	0.73
25	74.25	74.04	0.21	8.24	6.11	2.13
26	79.79	78.73	1.05	5.54	4.69	0.85
27	83.08	82.29	0.79	3.29	3.56	-0.26
28	85.90	84.97	0.93	2.82	2.68	0.14
29	87.41	86.99	0.42	1.51	2.02	-0.51
30	89.09	88.51	0.57	1.67	1.52	0.15
31	89.79	89.66	0.12	0.70	1.15	-0.45
32	90.40	90.53	-0.14	0.61	0.87	-0.26
33	90.80	91.20	-0.39	0.41	0.66	-0.26
34	91.10	91.70	-0.60	0.30	0.50	-0.21

The mean for observed data = 22.36592

The mean for expected data = 22.42302

Index of dissimilarity for cumulative prop. = 9.53630

Index of dissimilarity for actual prop. = 10.25460

Table C-5: Generalized Logistic Graduation of Proportions of First Marriage by Age: Female Cohort Aged 35 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.41	2.70	-2.29	0.41	2.70	-2.30
16	1.99	4.63	-2.63	1.59	1.93	-0.34
17	5.78	7.70	-1.93	3.78	3.08	0.71
18	13.49	12.38	1.11	7.71	4.68	3.03
19	21.46	19.05	2.42	7.98	6.67	1.31
20	30.49	27.82	2.68	9.03	8.77	0.26
21	38.65	38.29	0.36	8.16	10.48	-2.32
22	47.56	49.55	-1.99	8.91	11.26	-2.35
23	58.14	60.46	-2.31	10.57	10.89	-0.32
24	68.46	70.03	-1.57	10.32	9.58	0.74
25	78.49	77.82	0.67	10.03	7.79	2.23
26	85.24	83.80	1.44	6.76	5.98	0.77
27	89.91	88.23	1.69	4.67	4.42	0.25
28	92.99	91.42	1.57	3.08	3.19	-0.11
29	94.65	93.70	0.95	1.66	2.28	-0.62
30	95.62	95.31	0.31	0.97	1.62	-0.65
31	96.06	96.47	-0.41	0.44	1.15	-0.72
32	96.28	97.30	-1.02	0.22	0.83	-0.61
33	96.43	97.89	-1.47	0.15	0.60	-0.45
34	96.54	98.33	-1.79	0.11	0.44	-0.32

The mean for observed data = 22.48019

The mean for expected data = 22.66521

Index of dissimilarity for cumulative prop. = 13.18702

Index of dissimilarity for actual prop. = 9.31245

Table C-6: Generalized Logistic Graduation of Proportions of First Marriage by Age: Female Cohort Aged 50 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	2.03	3.55	-1.52	2.03	3.55	-1.52
16	7.21	8.73	-1.52	5.18	5.18	-0.00
17	17.19	18.07	-0.88	9.97	9.33	0.64
18	32.95	31.25	1.70	15.77	13.18	2.58
19	45.91	45.82	0.09	12.95	14.57	-1.61
20	60.85	58.87	1.98	14.94	13.06	1.89
21	68.49	68.99	-0.50	7.64	10.11	-2.48
22	74.55	76.19	-1.64	6.06	7.20	-1.14
23	79.40	81.12	-1.72	4.85	4.93	-0.08
24	83.23	84.45	-1.23	3.82	3.33	0.49
25	86.75	86.72	0.04	3.53	2.25	1.27
26	88.79	88.23	0.56	2.04	1.53	0.51
27	89.92	89.28	0.64	1.13	1.04	0.09
28	90.75	90.00	0.75	0.83	0.73	0.11
29	91.31	90.54	0.77	0.55	0.53	0.02
30	91.65	90.97	0.68	0.34	0.43	-0.09
31	91.80	91.38	0.42	0.15	0.41	-0.26
32	91.92	91.83	0.10	0.13	0.45	-0.32
33	92.01	92.37	-0.36	0.09	0.54	-0.46
34	92.09	93.04	-0.95	0.08	0.67	-0.59

The mean for observed data = 20.02779
The mean for expected data = 20.15294

Index of dissimilarity for cumulative prop. = 7.72585
Index of dissimilarity for actual prop. = 7.60258

Table C-7: Generalized Logistic Graduation of Proportions of First Marriage by Age: Male Cohort Aged 35 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.01	0.85	-0.79	0.01	0.81	-0.79
16	0.17	1.33	-1.16	0.15	0.52	-0.37
17	0.85	2.20	-1.34	0.69	0.87	-0.19
18	2.46	3.64	-1.18	1.61	1.44	0.17
19	5.23	5.99	-0.76	2.76	2.34	0.42
20	11.24	9.68	1.56	6.02	3.69	2.32
21	16.75	15.24	1.51	5.51	5.56	-0.05
22	24.03	23.05	0.98	7.29	7.816	-0.52
23	32.60	33.07	-0.48	8.56	10.02	-1.46
24	43.50	44.59	-1.09	10.90	11.51	-0.61
25	55.98	56.31	-0.33	12.48	11.73	0.76
26	66.18	66.95	-0.77	10.20	10.64	-0.44
27	75.54	75.68	-0.14	9.36	8.73	0.62
28	83.22	82.33	0.88	7.70	6.65	1.03
29	88.37	87.15	1.22	5.15	4.81	0.34
30	91.60	90.53	1.07	3.23	3.38	-0.15
31	93.01	92.86	0.15	1.42	2.33	-0.91
32	94.05	94.45	-0.40	1.03	1.59	-0.56
33	94.80	95.53	-0.73	0.75	1.08	-0.33
34	95.30	96.25	-0.95	0.50	0.72	-0.22

The mean for observed data = 24.77028

The mean for expected data = 24.84303

Index of dissimilarity for cumulative prop. = 7.37707

Index of dissimilarity for actual prop. = 5.65024

Table C-8: Generalized Logistic Graduation of Proportions of First Marriage by Age: Male Cohort Aged 50 in Urban China, 1987

Age	Obs. Cum. Prop.	Ex. Cum. Prop.	Dev. (O-E)	Obs. Prop.	Ex. Prop.	Dev. (O-E)
15	0.45	1.35	-0.90	0.45	1.35	-0.90
16	1.25	2.60	-1.35	0.80	1.25	-0.45
17	2.96	4.76	-1.80	1.71	2.16	-0.45
18	7.18	8.25	-1.07	4.22	3.48	0.73
19	12.99	13.45	-0.46	5.81	2.21	0.61
20	23.92	20.59	3.34	10.93	7.13	3.80
21	31.13	29.46	1.68	7.21	8.87	-1.66
22	39.48	39.43	0.05	8.35	9.97	-1.63
23	47.48	49.60	-2.12	8.00	10.17	-2.17
24	56.86	59.10	-2.25	9.38	9.50	-0.12
25	67.30	67.37	-0.08	10.44	8.27	2.17
26	75.30	74.21	1.09	8.00	6.84	1.17
27	80.40	79.66	0.73	5.10	5.45	-0.36
28	84.55	83.92	0.62	4.15	4.26	-0.11
29	87.55	87.21	0.33	3.00	3.29	-0.29
30	90.45	89.75	0.70	2.90	2.54	0.37
31	91.94	91.71	0.23	1.49	1.96	-0.47
32	93.03	93.23	-0.20	1.09	1.53	-0.43
33	93.93	94.43	-0.50	0.90	1.20	-0.30
34	94.39	95.38	-0.99	0.46	0.95	-0.49

The mean for observed data = 23.53134
The mean for expected data = 23.61995

Index of dissimilarity for cumulative prop. = 8.76729
Index of dissimilarity for actual prop. = 8.83449

APPENDIX D

Graduation of Nuptiality by Generalized Gompertz Function by Age, Sex and Residence

Table D-1: Generalized Gompertz Graduation of Nuptiality Rate by Age: Female Cohort Aged 35 in Rural China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.94	2.00	-1.06
16	3.26	3.34	-0.08
17	7.23	5.30	1.93
18	13.81	8.02	5.79
19	15.16	11.54	3.61
20	20.29	15.82	4.47
21	19.85	20.65	-0.80
22	22.98	25.65	-2.67
23	27.73	30.33	-2.61
24	31.72	34.16	-2.44
25	36.00	36.62	-0.62
26	34.18	37.37	-3.19
27	34.29	36.32	-2.02
28	33.66	33.60	0.06
29	27.39	29.59	-2.20
30	21.67	24.81	-3.14
31	14.86	19.81	-4.95
32	13.17	15.06	-1.89
33	12.80	10.90	1.90
34	10.71	7.51	3.20

Index of Dissimilarity = 20.96285

Table D-2: Generalized Gompertz Graduation of Nuptiality Rate by Age: Female Cohort Aged 50 in Rural China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	3.64	5.88	-2.24
16	7.66	8.39	-0.73
17	12.78	11.40	1.38
18	21.78	14.76	7.02
19	21.61	18.21	3.40
20	30.71	21.40	9.31
21	22.53	23.96	-1.43
22	23.00	25.56	-2.56
23	21.76	25.98	-4.22
24	25.34	25.16	0.18
25	27.80	23.21	4.59
26	23.49	20.40	3.09
27	15.84	17.08	-1.24
28	12.54	13.63	-1.08
29	8.18	10.36	-2.17
30	8.04	7.50	0.54
31	3.19	5.14	-1.98
32	2.56	3.40	-0.84
33	2.32	2.13	0.19
34	2.22	1.27	0.95

Index of Dissimilarity = 30.64907

Table D-3: Generalized Gompertz Graduation of Nuptiality Rate by Age: Male Cohort Aged 35 in Rural China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.09	0.20	-0.11
16	0.38	0.46	-0.08
17	1.22	0.98	0.24
18	3.29	1.94	1.35
19	5.11	3.52	1.59
20	11.17	5.92	5.25
21	9.90	9.20	0.70
22	13.09	13.20	-0.11
23	15.11	17.51	-2.41
24	19.02	21.47	-2.44
25	24.60	24.31	0.28
26	20.51	25.45	-4.94
27	18.70	24.61	-5.91
28	19.15	22.00	-2.85
29	13.09	18.17	-5.08
30	12.85	13.87	-1.02
31	7.82	9.78	-1.96
32	7.59	6.38	1.22
33	5.63	3.84	1.79
34	2.40	2.14	0.26

Index of Dissimilarity = 12.68814

Table D-4: Generalized Gompertz Graduation of Nuptiality Rate by Age: Male Cohort Aged 50 in Rural China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.97	1.16	-0.19
16	1.49	1.96	-0.47
17	2.75	3.13	-0.39
18	6.93	4.75	2.18
19	8.27	6.81	1.46
20	16.54	9.27	7.23
21	10.88	11.96	-1.08
22	13.16	14.62	-1.46
23	14.24	16.94	-2.70
24	18.11	18.62	-0.50
25	21.62	19.39	2.23
26	19.43	19.14	0.28
27	15.07	17.92	-2.85
28	15.37	15.89	-0.53
29	10.18	13.37	-3.19
30	12.47	10.66	1.82
31	6.22	8.05	-1.83
32	5.80	5.77	0.04
33	4.15	3.92	0.23
34	3.18	2.52	0.66

Index of Dissimilarity = 16.15340

Table D-5: Generalized Gompertz Graduation of Nuptiality Rate by Age: Female Cohort Aged 35 in Urban China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.41	0.75	-0.35
16	1.58	1.45	0.13
17	3.79	2.62	1.17
18	7.86	4.42	3.44
19	8.81	6.99	1.82
20	10.87	10.36	0.52
21	11.08	14.36	-3.28
22	13.54	18.66	-5.11
23	18.32	22.69	-4.37
24	21.95	25.84	-3.89
25	27.43	27.56	-0.13
26	27.14	27.52	-0.38
27	27.33	25.74	1.60
28	26.47	22.54	3.93
29	21.16	18.48	2.68
30	16.66	14.19	2.47
31	9.50	10.20	-0.71
32	5.43	6.87	-1.45
33	3.89	4.33	-0.44
34	3.07	2.56	0.51

Index of Dissimilarity = 18.27220

Table D-6: Generalized Gompertz Graduation of Nuptiality Rate by Age: Female Cohort Aged 50 in Urban China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	2.01	3.93	-1.92
16	5.15	5.82	-0.67
17	10.20	8.14	2.06
18	17.38	10.79	6.59
19	17.62	13.54	4.08
20	24.27	16.07	8.20
21	17.77	18.06	-0.29
22	17.55	19.21	-1.65
23	17.39	19.33	-1.95
24	16.98	18.42	-1.44
25	19.01	16.61	2.40
26	14.30	14.18	0.13
27	9.60	11.45	-1.85
28	7.95	8.76	-0.81
29	5.80	6.34	-0.53
30	3.87	4.34	-0.47
31	1.76	2.81	-1.05
32	1.55	1.73	-0.18
33	1.07	1.00	0.07
34	0.96	0.55	0.41

Index of Dissimilarity = 23.93568

Table D-7: Generalized Gompertz Graduation of Nuptiality Rate by Age: Male Cohort Aged 35 in Urban China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.01	0.06	-0.04
16	0.15	0.15	-0.00
17	0.69	0.37	0.32
18	1.61	0.82	0.79
19	2.79	1.68	1.12
20	6.15	3.18	2.97
21	6.02	5.58	0.44
22	8.39	9.03	-0.64
23	10.67	13.52	-2.85
24	14.97	18.69	-3.73
25	19.90	23.88	-3.98
26	20.77	28.19	-7.42
27	24.30	30.74	-6.44
28	27.14	30.97	-3.84
29	26.61	28.83	-2.22
30	24.36	24.79	-0.43
31	15.55	19.70	-4.15
32	13.83	14.46	-0.64
33	11.88	9.81	2.07
34	9.14	6.15	3.00

Index of Dissimilarity = 10.71275

Table D-8: Generalized Gompertz Graduation of Nuptiality Rate by Age: Male Cohort Aged 50 in Urban China, 1987

Age	Observed Nuptiality Rate (%)	Expected Nuptiality Rate (%)	Deviation (O - E)
15	0.45	0.60	-0.15
16	0.80	1.07	-0.27
17	1.72	1.82	-0.09
18	4.25	2.93	1.32
19	6.07	4.51	1.56
20	11.82	6.59	5.22
21	9.05	9.17	-0.12
22	11.43	12.13	-0.70
23	12.40	15.26	-2.86
24	16.39	18.25	-1.86
25	21.59	20.77	0.82
26	21.81	22.48	-0.67
27	18.70	23.14	-4.44
28	19.14	22.65	-3.51
29	17.70	21.10	-3.40
30	20.88	18.68	2.20
31	14.47	15.74	-1.27
32	12.70	12.61	0.09
33	12.14	9.61	2.53
34	7.27	6.96	0.31

Index of Dissimilarity = 14.04290

APPENDIX E

Chinese Nuptiality Tables
by Age, Sex and Residence

Table E-1: Nuptiality Tables: Female Cohort Aged 35 in Rural China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0200	100000	2002	99171	2002	98999	707323	99.2	7.073
16	.0334	97998	3272	97169	5274	96362	608324	99.2	6.207
17	.0530	94726	5024	93897	10297	92214	511961	99.1	5.405
18	.0802	89703	7193	88873	17490	86106	419747	99.1	4.679
19	.1154	82510	9525	81680	27015	77747	333641	99.0	4.044
20	.1582	72985	11547	72155	38563	67211	255894	98.0	3.506
21	.2064	61437	12684	60608	51246	55095	188683	98.6	3.071
22	.2565	48754	12504	47924	63750	42502	133587	98.3	2.740
23	.3033	36250	10996	35420	74746	30752	91086	97.7	2.513
24	.3416	25254	8626	24424	83372	20941	60334	96.7	2.389
25	.3662	16628	6089	15798	89461	13583	39393	95.0	2.369
26	.3737	10539	3939	9710	93400	8570	25810	92.1	2.449
27	.3632	6600	2397	5771	95797	5402	17240	87.4	2.612
28	.3360	4203	1412	3374	97209	3497	11838	80.3	2.816
29	.2959	2791	826	1962	98035	2378	8341	70.3	2.988
30	.2481	1965	488	1136	98522	1721	5963	57.8	3.034
31	.1981	1478	293	648	98815	1331	4242	43.9	2.871
32	.1506	1185	178	255	98994	1096	2910	30.0	2.456
33	.1089	1006	110	177	99103	952	1815	17.6	1.803
34	.0751	897	67	67	99171	863	863	7.5	0.962

Table E-2: Nuptiality Tables: Female Cohort Aged 50 in Rural China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0588	100000	5882	95784	5882	97059	608801	95.8	6.088
16	.0839	94118	7897	89902	13778	90170	511742	95.5	5.437
17	.1140	86222	9831	82005	23609	81306	421572	95.1	4.889
18	.1476	76391	11278	72174	34887	70752	340266	94.5	4.454
19	.1821	65113	11858	60897	46745	59184	269514	93.5	4.139
20	.2140	53255	11398	49039	58143	47556	210330	92.1	3.949
21	.2396	41857	10031	37641	68174	36842	162774	89.9	3.889
22	.2556	31826	8136	27610	76310	27758	125932	86.8	3.957
23	.2598	23690	6155	19474	82465	20613	98174	82.2	4.144
24	.2516	17535	4412	13319	86877	15329	77561	76.0	4.423
25	.2321	13123	3046	8907	89922	11601	62232	67.9	4.742
26	.2040	10078	2056	5861	91978	9050	50631	58.2	5.024
27	.1708	8022	1370	3805	93348	7337	41582	47.4	5.184
28	.1363	6652	906	2435	94255	6198	34245	36.6	5.148
29	.1036	5745	595	1529	94850	5448	28046	26.6	4.882
30	.0750	5150	386	934	95236	4957	22599	18.1	4.388
31	.0517	4764	247	547	95483	4641	17642	11.5	3.703
32	.0340	4517	154	301	95636	4440	13001	6.7	2.878
33	.0213	4364	93	147	95729	4317	8561	3.4	1.962
34	.0127	4271	54	54	95784	4244	4244	1.3	0.994

Table E-3: Nuptiality Tables: Male Cohort Aged 35 in Rural China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0020	100000	200	91692	200	99900	1021074	91.7	10.211
16	.0046	99800	461	91491	661	99569	921174	91.7	9.230
17	.0098	99339	977	91030	1638	98850	821605	91.6	8.271
18	.0194	98362	1905	90053	3543	97409	722755	91.6	7.348
19	.0352	96457	3398	88149	6941	94758	625345	91.4	6.483
20	.0592	93059	5510	84751	12451	90304	530587	91.1	5.702
21	.0920	87549	8052	79241	20503	83523	440283	90.5	5.029
22	.1320	79497	10495	71189	30998	74249	356760	89.5	4.488
23	.1751	69002	12083	60693	43082	62960	282510	88.0	4.094
24	.2147	56918	12218	48610	55299	50809	219551	85.4	3.857
25	.2431	44701	10868	36392	66168	39266	168741	81.4	3.775
26	.2545	33832	8610	25524	74778	29527	129475	75.4	3.827
27	.2461	25222	6208	16914	80986	22118	99947	67.1	3.963
28	.2200	19014	4183	10706	85169	16922	77829	56.3	4.093
29	.1817	14831	2695	6522	87864	13483	60907	44.0	4.107
30	.1387	12136	1683	3827	89547	11294	47424	31.5	3.908
31	.0978	10453	1022	2144	90570	9941	36129	20.5	3.456
32	.0638	9430	601	1122	91171	9130	26188	11.9	2.777
33	.0384	8829	339	520	91510	8659	17059	5.9	1.932
34	.0214	8490	181	181	91692	8399	8399	2.1	0.989

Table E-4: Nuptiality Tables: Male Cohort Aged 50 in Rural China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0116	100000	1164	89144	1164	99418	959528	89.1	9.595
16	.0196	98836	1939	87980	3103	97866	860111	89.0	8.702
17	.0313	96897	3037	86041	6140	95397	762244	88.8	7.867
18	.0475	93860	4454	83004	10594	91633	666866	88.4	7.105
19	.0681	89406	6091	78550	16685	86361	575233	87.9	6.434
20	.0927	83315	7723	72459	24407	79454	488872	87.0	5.868
21	.1196	75593	9038	64736	33446	71073	409418	85.6	5.416
22	.1462	66554	9730	55698	43175	61690	338345	83.7	5.084
23	.1694	56825	9629	45968	52804	52010	276655	80.9	4.869
24	.1862	47196	8787	36340	61591	42803	224645	77.0	4.760
25	.1939	38409	7448	27553	69038	34686	181842	71.7	4.734
26	.1914	30962	5927	20106	74965	27998	147156	64.9	4.753
27	.1792	25035	4485	14179	79450	22792	119158	56.6	4.760
28	.1589	20550	3266	9693	82717	18916	96366	47.2	4.689
29	.1337	17283	2310	6427	85027	16128	77449	37.2	4.481
30	.1066	14973	1595	4117	86622	14175	61321	27.5	4.095
31	.0805	13378	1077	2521	87699	12839	47146	18.8	3.524
32	.0577	12301	710	1444	88409	11946	34306	11.7	2.789
33	.0392	11591	454	735	88863	11364	22361	6.3	1.929
34	.0252	11137	281	281	89144	10997	10997	2.5	0.987

Table E-5: Nuptiality Tables: Female Cohort Aged 35 in Urban China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0075	100000	753	95008	753	99624	874429	95.0	8.744
16	.0145	99247	1140	94255	2193	98527	774806	95.0	7.807
17	.0262	97807	2559	92815	4752	96528	676278	94.9	6.914
18	.0442	95248	4210	90256	8962	93143	579751	94.8	6.087
19	.0699	91038	6365	86046	15327	87856	486607	94.5	5.345
20	.1036	84673	8769	79681	24906	80289	398752	94.1	4.709
21	.1436	75904	10903	70912	34998	70453	318463	93.4	4.196
22	.1866	65002	12127	60009	47125	58938	248010	92.3	3.815
23	.2269	52875	11997	47882	59123	46876	189072	90.6	3.576
24	.2584	40877	10563	35885	69686	35596	142196	87.8	3.479
25	.2756	30314	8354	25321	78041	26137	106600	83.5	3.517
26	.2752	21959	6044	16967	84084	18938	80463	77.3	3.664
27	.2574	15916	4096	10923	88181	13867	61526	68.6	3.866
28	.2254	11819	2664	6827	90845	10487	47658	57.8	4.032
29	.1848	9155	1692	4163	92537	8309	37171	45.5	4.060
30	.1419	7463	1059	2471	93596	6934	28862	33.1	3.867
31	.1020	6404	653	1412	94249	6077	21928	22.0	3.424
32	.0687	5751	395	758	94644	5553	15851	13.2	2.756
33	.0433	5356	232	363	94876	5240	10298	6.8	1.923
34	.0256	5124	131	131	95008	5058	5058	2.6	0.987

Table E-6: Nuptiality Tables: Female Cohort Aged 50 in Urban China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0393	100000	3931	88581	3931	98035	773748	88.6	7.737
16	.0582	96069	5587	84650	9518	93275	675713	88.1	7.034
17	.0814	90482	7368	79063	16886	86798	582438	87.4	6.437
18	.1079	83114	8970	71659	25856	78629	495640	86.3	5.963
19	.1354	74144	10037	62725	35894	69125	417011	84.6	5.624
20	.1607	64106	10303	52688	46197	58955	347886	82.2	5.427
21	.1806	53803	9717	42384	55914	48945	288932	78.8	5.370
22	.1921	44086	8468	32667	64382	39852	239987	74.1	5.444
23	.1933	35618	6887	24199	71269	32175	200135	67.9	5.619
24	.1842	28731	5293	17313	76651	26085	167960	60.3	5.846
25	.1661	23439	3893	12020	80454	21492	141875	51.3	6.053
26	.1418	19546	2771	8127	83225	18160	120383	41.6	6.159
27	.1145	16775	1921	5356	85146	15814	102223	31.9	6.094
28	.0876	14854	1301	3435	86447	14203	86409	23.1	5.817
29	.0634	13553	859	2134	87306	13124	72205	15.7	5.328
30	.0434	12694	551	1276	87857	12419	59082	10.0	4.654
31	.0281	12143	342	725	88198	11973	46663	6.0	3.843
32	.0173	11802	204	383	88402	11700	34690	3.2	2.939
33	.0100	11598	116	180	88518	11540	22990	1.5	1.982
34	.0055	11482	63	63	88581	11450	11450	0.6	0.997

Table E-7: Nuptiality Tables: Male Cohort Aged 35 in Urban China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0006	100000	58	95389	58	99971	1082259	95.4	10.823
16	.0015	99942	152	95330	211	99865	982288	95.4	9.829
17	.0037	99789	366	95178	577	99606	882423	95.4	8.843
18	.0082	99423	8113	94812	1388	99018	782817	95.4	7.874
19	.0168	98612	1652	94001	3040	97786	683799	95.3	6.934
20	.0318	96960	3083	92348	6123	95418	586013	95.2	6.044
21	.0558	93877	5234	89265	11358	91259	490595	95.1	5.226
22	.0903	88642	8007	84031	19364	84639	399335	94.8	4.505
23	.1352	80636	10901	76024	30265	75185	315696	94.3	3.903
24	.1869	69735	13036	65123	43301	63217	239511	93.4	3.435
25	.2388	56699	13541	52087	56842	49928	176294	91.9	3.109
26	.2819	43158	12166	38546	69008	37075	126366	89.3	2.928
27	.3074	30992	9527	26381	78535	26229	89291	85.1	2.881
28	.3097	21465	6648	16854	85183	18141	63062	78.5	2.938
29	.2883	14817	4272	10206	89454	12681	44921	68.9	3.032
30	.2479	10546	2615	5934	92069	9238	32240	56.3	3.057
31	.1970	7931	1562	3320	93631	7150	23001	41.9	2.900
32	.1446	6369	921	1757	94552	5908	15851	27.6	2.489
33	.0981	5448	534	836	95087	5181	9943	15.4	1.825
34	.0615	4913	302	302	95389	4762	4762	6.1	0.969

Table E-8: Nuptiality Tables: Male Cohort Aged 50 in Urban China, 1987

Age	n_x	N_x	M_x	ML_x	EVM_x	S_x	NEV_x	PM_x	E^n_x
15	.0060	100000	598	93294	598	99701	1012028	93.3	10.120
16	.0107	99402	1062	92696	1660	98871	912327	93.3	9.178
17	.0182	98340	1785	91634	3445	97447	813456	93.2	8.272
18	.0293	96555	2833	89849	6278	95138	716009	93.1	7.416
19	.0451	93722	4227	87016	10506	91608	620871	92.8	6.625
20	.0659	89494	5902	82789	16407	86544	529263	92.5	5.914
21	.0917	83593	7665	76887	24072	79760	442720	92.0	5.296
22	.1213	75928	9208	69222	33280	71324	362959	91.2	4.780
23	.1526	66720	10178	60014	43459	61630	291636	89.9	4.371
24	.1825	56541	10320	49836	53778	51381	230005	88.1	4.068
25	.2077	46222	9600	39516	63378	41422	178624	85.5	3.865
26	.2248	36622	8232	29916	71610	32506	137202	81.7	3.746
27	.2314	28390	6569	21684	78179	25105	104697	76.4	3.688
28	.2265	21821	4943	15115	83123	19349	79591	69.3	3.648
29	.2110	16877	3560	10172	86683	15097	60242	60.3	3.569
30	.1868	13317	2488	6611	89171	12073	45145	49.6	3.390
31	.1574	10829	1704	4123	90876	9977	33073	38.1	3.054
32	.1261	9124	1151	2419	92026	8549	23096	26.5	2.531
33	.0961	7974	766	1268	92793	7591	14547	15.9	1.824
34	.0696	7207	502	502	93294	6957	6957	7.0	0.965